Development of the Fire Emissions Tradeoff Model (FETM) and Application to the Grande Ronde River Basin, Oregon

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Portland, Oregon

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Contract No. 53-82FT-03-2

February 1996

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Acknowledgements

The authors would like to acknowledge the following individuals, whose teamwork, skill, and good humor contributed greatly to the success of this project.

Development and Subsequent Review of Utilization, Mechanical Treatment, Wildfire, Prescribed Fire, and Natural Succession Transition Matrices for the Grande Ronde River Basin:

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Expansion of National Fire Danger Rating System Fuel Models for Use in Grande Ronde River Basin:

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Collection of Meteorological Data and Preparation and Running of pcFIRDAT Model Using Extended NFDRS Fuel Models:

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Summary

A PC-based stochastic simulation model–the Fire Emissions Tradeoff Model (FETM)–has been developed to demonstrate the tradeoffs between prescribed fire and wildfire smoke emissions under diverse environmental conditions, ecosystem management strategies, and wildfire protection policies. The model was developed as part of an overall study to determine the appropriate prescribed fire treatment policy within the 1.2-million-acre Grande Ronde River Basin in northeast Oregon. The study objective was to determine the level of prescribed fire treatment that would minimize the total emissions from both prescribed fire and wildfire within the Basin for a given level of utilization and mechanical treatment.

The FETM tracks the annual distribution of acres in discrete fuel condition classes (FCCs) following disturbance by utilization, mechanical treatment, prescribed fire, and wildfire; or in the absence of disturbance, by natural succession. Wildfire emissions are computed for three National Fire Danger Rating System (NFDRS) fire weather classes–high, very high, and extreme. Prescribed fire emissions are computed for a single NFDRS fire weather class (low) representing spring or fall burning conditions. The model includes a state-of-the-art fire behavior algorithm for assessing the feedback between surface fuel type, loading, and structure, and the wildfire size and frequency at the landscape level.

The model was evaluated with stand and surface fuel data obtained from surveys of 10 sample watersheds within the Grande Ronde River Basin. The sample watersheds encompass 204,000 acres, or roughly 17 percent, of the Basin. A total of 188 different FCCs representing different combinations of vegetation type, age class (surrogate for stand structure), loading class, and activity class were identified. They included 70 natural-stand FCCs and 118 activity fuel FCCs. Fire history and weather data for the Basin were obtained from the Umatilla and Wallowa-Whitman National Forests.

The preliminary modeling was performed for six levels of prescribed fire treatment (zero to 5 percent of available acres in targeted FCCs, in 1 percent increments) and 100 years of simulation. The results from 30 independent model runs were averaged to assess the most probable outcome of the model in each year and at each level of treatment. The base management policy for the Grande Ronde River Basin included utilization on approximately 3,600 acres (0.3 percent of the area) each year and mechanical treatment on approximately 1,200 acres (0.1 percent of the area) each year.

On the basis of the preliminary modeling results, total emissions for the first 30 years of simulation are expected to increase monotonically with increasing levels of prescribed fire treatment. From 30 to 80 years, total emissions are expected to remain relatively constant with increasing levels of prescribed fire treatment. From 80 to 100 years, an absolute minimum in the total emissions curve occurs at about the 2 percent level of prescribed fire treatment, which equates to about 24,000 acres per year.

Although the model is not currently capable of evaluating varying levels of prescribed fire treatment within the same 100-year simulation period (the model assumes a fixed level of treatment for the entire period), it might be possible to minimize the impact from a more

active prescribed fire treatment program by gradually increasing the level of prescribed fire treatment over time within the Basin. The level of treatment might be increased from about 1 percent of the available area (12,000 acres) in the starting year, to 2 percent of the available area (24,000 acres) by the 50th year, and then to 5 percent of the available area (60,000 acres) by the 70th year without dramatically increasing the total smoke emissions within the Basin. According to the preliminary modeling results, emissions might be expected to increase from about 6.6 million pounds of PM10 (particulate matter less than 10 micrometers in diameter) in the starting year to about 7.0 million pounds of PM10 by year 50, and then decrease to 6.2 million pounds of PM10 by year 70. Overall, a net decrease in total emissions of about 6 percent (400,000 pounds or 200 tons per year) would be expected over starting levels.

Chapter 1
Introduction

This report summarizes the development and initial evaluation of a stochastic simulation model–the Fire Emissions Tradeoff Model (FETM)–to predict the emissions of pollutants from prescribed fire and wildfire activities in the 1.2-million-acre Grande Ronde River Basin in northeastern Oregon (the study area). FETM was designed to evaluate the relationship between prescribed fire and wildfire smoke emissions under different fuel management strategies used in the National Forests of northeastern Oregon, including a variety of utilization and mechanical treatment options as well as prescribed fire. It has been widely conjectured, but never proven, that fuel reduction through the intensive use of prescribed fire reduces the size and frequency of wildfire, and ultimately leads to reduced total smoke emissions (wildfire plus prescribed fire). FETM was developed to provide a quantitative basis for recommending a level of prescribed fire treatment within the study area that would minimize the combined emissions from prescribed fire and wildfire.

Initially applied to the Grande Ronde River Basin of Oregon, FETM is also applicable in other fire-affected environments in the western United States.

1.1 Objectives

Development of FETM began in late 1993. The objectives of the study were threefold (CH2M HILL, 1993):

- To design and construct a stochastic simulation model that could be used to evaluate the tradeoff between prescribed fire and wildfire emissions at different levels of fuel treatment on National Forest lands within the study area
- To evaluate the tradeoffs between prescribed fire and wildfire emissions on National Forest lands in northeastern Oregon
- To quantify the level of prescribed fire treatment required to minimize the total emissions of particulate matter from prescribed fire and wildfire in the study area

1.2 Background

Prescribed fire is an essential tool for managing National Forest lands in the Pacific Northwest. Prior to 1993, approximately 20,000 to 25,000 acres were treated by prescribed fire in northeastern Oregon (Hilbruner, 1995).

Over the past decade, repeated disease and insect attacks in the drought-weakened mixed conifer forests of northeastern Oregon and southwestern Washington have dramatically

increased the fuel loading on approximately 2.5 million acres (USDA Forest Service, 1992), and thus placed them at increased risk of large wildfires. The greatest fuel buildups are in the Blue Mountains of northeastern Oregon. To reduce the current wildfire hazard, and to achieve other resource management objectives, the USDA Forest Service is proposing to sharply increase its prescribed burning program on four National Forests–the Wallowa-Whitman, Umatilla, Malheur, and Ochoco–encompassing nearly 6 million acres in northeastern Oregon. The expanded prescribed burning program is needed to restore "health" to these forest ecosystems, that is, to reduce their susceptibility to major disturbances such as drought, disease, insects, and fire through alterations in species composition, fuel loading, and fuel structure.

For air regulators to accept a substantial increase in prescribed fire emissions, it might be necessary to demonstrate that the program would reduce the total emissions from both wildfire and prescribed fire, or at least to show that increased use of prescribed fire would not greatly increase the total emissions from wildfire and prescribed fire. Studies in the southeastern United States (Davis and Cooper, 1963) have shown that prescribed burning can reduce the number, size, and intensity of wildfires. However, similar studies have not been performed in the Pacific Northwest. FETM was developed to test the hypothesis that a reduction in total smoke emissions would occur after an expansion of the existing prescribed fire program in northeastern Oregon.

Chapter 2
Modeling Approach and FETM Architecture

2.1 Modeling Approach

The Fire Emissions Tradeoff Model (FETM) is a stochastic, dynamic, nonspatial simulation model designed to demonstrate the potential tradeoffs between wildfire and prescribed fire emissions over regions or subregions under diverse environmental conditions, ecosystem management strategies, and wildfire protection policies. To model changes in vegetation composition and fuel loading over time, the model uses a system of discrete matrix operations. FETM currently tracks the annual distribution of acres in 188 unique fuel condition classes (FCCs) following disturbance by utilization (harvesting), mechanical treatment, prescribed fire, and wildfire, and, in the absence of disturbance, natural succession. Each FCC represents a unique combination of vegetation type, age class (surrogate for stand structural stage), loading class, and activity class. As such, each FCC has potentially different utilization, mechanical treatment, and prescribed fire treatment options; successional pathways; wildfire behaviors (e.g., fire spread rate); fuel consumption rates; and pollutant emissions.

For a given run, FETM uses fixed annual rates of utilization, mechanical treatment, and natural succession appropriate for each FCC. These FCC-specific annual rates (or *transfer coefficients*) define the magnitude and direction of change among the 188 FCCs within each of the three *transition matrices* (i.e., utilization, mechanical treatment, natural succession). The transfer coefficients must be determined by experienced forest managers, ecologists, and silviculturists. Similar transition matrices are defined for each of the different levels of prescribed fire treatment.

Wildfire is treated as a random (stochastic) event whose frequency and size varies according to the fire weather conditions and the vegetation composition within the modeling domain. For example, a greater frequency of large fires is expected to occur under extreme fire weather conditions and high fuel loading than under moderate or high fire weather conditions and low fuel loading. Characterization of the appropriate fire behavior for each FCC must be determined by experienced fire behavior analysts.

Based on this approach, numerous runs (30 iterations) of FETM were planned to provide an adequate sampling of the consequences of wildfire and management practices. A total of six levels of prescribed fire treatment were evaluated over a 100-year simulation time period. The model was initially tested using data from the 1.2-million-acre Grande Ronde River Basin in northeast Oregon.

2.2 FETM Architecture

The Fire Emissions Tradeoff Model is composed of four component algorithms:

- Acreage distribution algorithm
- Wildfire acreage and effects algorithm
- Wildfire emissions algorithm
- Prescribed fire emissions algorithm

The acreage distribution algorithm tracks changes in the vegetation composition of the Grande Ronde River Basin over time as a function of management practices, fire, and natural succession. The wildfire acreage and effects algorithm computes the frequency and sizes of wildfires by fire weather class. The wildfire emissions algorithm and prescribed fire emissions algorithm compute emissions based on numbers of fires, fire sizes, fuel consumption by fire weather class, and fuel emission factors. Each of these component algorithms is described below.

2.2.1 Acreage Distribution Algorithm

Description

The core of the Fire Emissions Tradeoff Model is an acreage distribution algorithm that tracks changes in vegetation states within the Grande Ronde River Basin over time. Because the primary output is fire emissions, which are driven by fire behavior and fuel consumption, the vegetation states are described in terms of fuel condition classes (FCCs). These FCCs are used as surrogates for the actual fuel loading conditions that occur within the study area. The FCCs were defined on the basis of observable characteristics, such as overstory vegetation type, stand age, fuel loading category, and management class (i.e., unmanaged or natural, and managed, or activity by type). In all, 188 different FCCs have been included in the model to describe the current and future composition of the Grande Ronde River Basin (see Chapter 3).

In the model, as in nature, the distribution of acreage in each FCC changes over time as a result of natural and human-caused disturbances such as utilization (e.g., final harvest), mechanical treatment (e.g., crushing), prescribed fire, and wildfire. Changes also occur in the absence of disturbance (e.g., growth and succession). The rate and direction of change has been defined in terms of "transition matrices," which were developed for this investigation.

The transition matrices use a discrete-time modeling approach to update the acreage distribution in the previous year to the present. Each matrix is made up of n x n elements ("transfer coefficients"), which define the fraction of the total acreage in an FCC that is transferred to another FCC through the action of utilization, mechanical treatment, prescribed fire, wildfire, and natural succession in each year of the simulation. Each column of the matrix represents the FCC being transferred *from*, and each row in the column represents the FCC(s) being transferred *to*. For example, a value of 0.05 at row 34, column 3 indicates that 5 percent of the previous year's acreage contained in FCC 3 is transferred to FCC 34 in the current year. All transition matrices have been fixed in time; that is, the rates of transfer are constant from year to year.

In the absence of disturbance, stands are expected to develop in an uninterrupted, stepwise manner toward an endpoint that perpetuates itself; that is, toward a climax state (Clements, 1936). The progression is typically from low surface fuel loading (relatively low flammability) to high surface fuel loading (relatively high flammability).

With disturbance, particularly wildfire, the changes across vegetation states may take multiple pathways, creating a mosaic of landscape patterns. The effects of harvesting practices or fire might be to maintain a forest in a parklike condition or set it back to an earlier successional stage, depending on the assumptions made about known species and vegetative community responses to different disturbance regimes.

Historically, large wildfires have been the single greatest contributor to change in the acreage distribution from year to year. For this reason, this investigation has focused on "escaped" fires, which are defined as fires greater than 10 acres based on modeling using the National Fire Management Analysis System (NFMAS). "Escaped" fires are those that escape initial attack and consume fuels over relatively large areas. The greater the acreage consumed by large wildfires, the greater the shift in the acreage distribution from high-flammability fuels to low-flammability fuels. On the other hand, the greater the number of acres in the most flammable classes that are treated to reduce fuel loading (by prescribed fire or other means), the lower the total acreage consumed by wildfire, due to a direct link between fuel loading and fire spread (see Section 2.3).

General Equation

The equation describing this general, nonspatial acreage distribution algorithm is (in tensor notation) as follows:

$$a_t = \mathbf{S}\,[\,(\,\mathbf{P}_l\,(\,\mathbf{M}\,(\,\mathbf{U}\,a_{t-1}\,)\,)\,) + w_t\,] \qquad (2\text{-}1)$$

Here, a_t is the acreage distribution vector and **U**, **M**, **P**, and **S** are transition matrices for utilization, mechanical treatment, prescribed fire, wildfire, and natural succession, respectively. The subscript t is time. The subscript l is the prescribed fire treatment policy, which specifies the fraction of the total acreage in "targeted" FCCs that are treated by prescribed fire each year. The column vector w_t specifies the net change in the acreage distribution vector caused by random fire events in the current year.

Equation 2-1 illustrates the hierarchy of matrix-vector operations in FETM. The utilization matrix, **U**, is multiplied by the acreage distribution vector in the previous year, a_{t-1}, to yield a modified acreage distribution vector. This modified vector is then multiplied by the mechanical treatment matrix, **M**, and the prescribed fire transition matrix, **P**, to yield a new modified acreage distribution vector. Next, the wildfire acreage net-change vector, w_t, is added to the modified acreage distribution vector, and the resulting vector is multiplied by the natural succession transition matrix, **S**, to yield the final acreage distribution vector in the current year, a_t.

Equation 2-1 does not include a wildfire effects transition matrix. Instead, the wildfire effects transition matrix, **W**, is used to derive the wildfire acreage net-change vector, w_t. The

methodology used to compute the wildfire net change vector is described in the wildfire acreage and effects algorithm.

Development of the five transition matrices (U, M, P, W, and S) and the initial acreage distribution vector (a) is described in Chapter 3.

2.2.2 Wildfire Acreage and Effects Algorithm

Description

When wildfires occur in an ecosystem, the fuel type, fuel loading, structure, and flammability change as the vegetative composition and structure changes. In FETM, this change is represented as a series of discrete shifts in the number of acres in each of the various fuel condition classes. The magnitude and direction of these shifts depends on wildfire numbers, sizes, and expected ecological effects. The model simulates these factors within the study area based on site-specific fuel loading and structure data, historical fire frequencies, and fire weather conditions.

The number of acres burned by wildfire each year is the product of the weighted-average fire size (acres) and wildfire frequency (numbers per year), summed over all fire weather classes. In this investigation, the weighted-average fire size was determined by summing the final fire sizes for individual FCCs (assuming that fires burn homogeneously within each FCC), weighted by the fractional distribution of acreage in each FCC at the beginning of the simulation time period. The weighted-average fire size was then "mapped" back onto the ground using the same fractional distribution of acreage in each FCC. This vector of wildfire acres by FCC was then matrix-multiplied by the wildfire effects transition matrix (minus the identity matrix) to derive the net wildfire acreage by FCC attributable to wildfire in the year of simulation.

The following sections describe the general equation, fire frequency, fire sizes, and fire effects.

General Equations

In Equation 2-1, the elements of column vector w_t represent for each FCC the net gain or loss of acres attributable to wildfires in year t. For a given year t and fire weather class i, the net acreage change is a function of fire numbers, fire sizes, and effects:

$$w_i = (\mathbf{W} - \mathbf{I})(o_i\ F_i)\, d \qquad (2\text{-}2)$$

where

w = column vector containing net change in acreage by fuel condition class attributable to random wildfire events

W = n x n wildfire effects transition matrix, where n is the number of fuel condition classes;

$\mathbf{I}$ = n x n identity matrix;

o_i = vector representing wildfire frequency (i.e., annual-average number of fires) in the ith fire weather class;

F_i = final fire size in the ith fire weather class;

i = fire weather class (high, very high, extreme) associated with fire events;

j = fuel condition class;

$\sum$ = operator that sums the fire sizes by fuel condition class and weather class from j = 1 through j = N fuel condition classes.

Equation 2-2 constitutes a coarse negative (behavior dampening) feedback mechanism on the system, particularly fire size at the landscape level. The landscape-scale fire size is the number of fires, o_i, times the final fire size, F_i. The initial behavior of the feedback mechanism depends on the relative proportion of the study area occupied by FCCs with low rates of fire spread versus those with high rates of fire spread. If the proportion of the total area occupied by FCCs with high rates of spread is large, then large wildfires will be produced that will rapidly convert the area to a lower flammability, at which time the average wildfire size will decrease. Conversely, if the proportion occupied by FCCs with relatively low rates of spread is large, then small wildfires will result that will allow a slow, steady increase in fuel loadings to occur over time, leading to larger and larger average wildfire sizes. Over time, the relative proportion of acres in high rate-of-spread and low rate-of-spread FCC will fluctuate back and forth (gentle rise, steep decline; similar to that which occurs in nature). The curves should approach, but never achieve, an equilibrium state, given the irregular and infrequent nature of wildfire in the inland western United States.

Wildfire Frequency (o_i)

FETM computes the number of fires that occur annually in three National Fire Danger Rating System (NFDRS) fire weather classes: high, very high, and extreme. In the current version of the model, these three fire weather classes have been defined as the 65th, 90th, and 98th percentile values of the spread component, respectively. The model evaluates these three fire weather classes because they are the classes that are associated with the largest fires and that typically result in the greatest proportion of the total acreage burned over time (Carlton, 1994). The method of calculation is described below.

Poisson Probability Distribution

In FETM, the number of fires that occur annually in each of the three fire weather classes is computed as a discrete random variable. For each fire weather class, random numbers are drawn from a uniform probability distribution, which are then mapped onto a cumulative Poisson probability distribution that yields the annual number of fire events. The mean number of fires for each of the distributions must be computed from historical fire occurrence data for the study area (see Chapter 3).

A Poisson probability distribution is a discrete probability distribution, which means that the outcome of the random variable (k) is uniformly distributed over the interval from [k,k+1]. One characteristic of the Poisson probability distribution is that the mean of the distribution is equal to its variance over a range of values from [0, ∞].

As with all probability models, the adequacy of the Poisson distribution is determined by whether the model provides a reasonable approximation of the actual number of fires that have occurred, or are expected to occur, each year. This is discussed in greater detail in Chapter 4.

Area-Weighted-Average Fire Frequency

In the model, the mean of the probability distribution for each fire weather class (i.e., the *area-weighted-average fire frequency*) is determined by multiplying the area-weighted-average probability that a "large" fire will occur (i.e., the probability that a fire start will exceed the threshold fire size of 10 acres) times the expected number of fire starts per year.

The probability that a fire start will grow to achieve a large size varies by vegetation type and FCC. In general, the slash and shrub fuel models have a higher probability of achieving large size than the timber litter and grass fuel models because of their greater spread rates, longer flame lengths, and overall greater resistance to suppression. Fuels treatment–whether from utilization, mechanical treatment, wildfire, or prescribed fire–alters the structure and composition of fuel on the landscape, moving it from low flammability to high flammability, or from high flammability to low flammability, in response to the type and degree of disturbance. As the landscape changes from FCCs with a high probability of achieving large fire size to those with a lower probability of achieving large fire size, the total frequency of wildfires above the threshold size should decrease.

To account for this phenomenon, a feedback mechanism was constructed in the model to compute the *area-weighted-average fire frequency* for each fire weather class. The area-weighted-average fire frequency is the area-weighted-average probability that a fire will achieve "large" size (i.e., probability of "large" fires, weighted by the proportion of the total area in each FCC at the beginning of the simulation period) times the total frequency of all fires in the fire weather class. The equation describing this mechanism for an individual fire weather class is:

$$o_i = T_i \sum_{j=1}^{N} d_j \, p_{i,j} \tag{2-3}$$

where

o_i = vector representing the area-weighted-average fire frequency in the ith fire weather class;

T_i = scalar value representing the historical frequency of wildfires for an individual fire weather class (total frequency of all fires times the proportion of time allocated to

each fire weather class in an average season). This variable is expressed in the model as a column vector T_i for the ith fire weather class;

d_j = column vector representing the fractional distribution of acres contained in each of the j fuel condition classes (j = 1, 2, ..., 188), computed at the beginning of each simulation time step;

p_j = column vector representing the probability that fires will exceed the 10-acre (arbitrary) threshold size for the j fuel condition class (j = 1, 2,..., 188).

The historical total wildfire frequency (T_i) applied to the Grande Ronde River Basin is described in Section 3.6.

The probability that fires will exceed the 10-acre threshold fire size (p_j) for each FCC was estimated using the Forest Service's Initial Attack Analyzer (IAA). IAA is a component of NFMAS, which is located on the USDA Forest Service's mainframe computer in Kansas City, Missouri. It is also available in IBM-compatible format for use on personal computers. The IAA module was run using fire weather and fuels data representing the study area, and a generic fire suppression organization representing nine National Forests in the Columbia River Basin that have fire environments similar to the study area. These nine forests were the Fremont, Ochoco, Deschutes, Wallowa-Whitman, Umatilla, and Malheur in Oregon, the Boise and Payette in Idaho, and the Wenatchee in Washington. The generic fire organization was modeled at the *most efficient level (MEL) minus 20 percent*. Modifications were made to reflect the lack of fire protection resource availability during multiple fire occurrence episodes, which accounts for 75 percent to 85 percent of total fire occurrences in Region 6. Within Regions 1, 4, and 6 of the Forest Service, and during the period from 1970 through 1994, between 69 percent and 79 percent of all fires greater than 100 acres resulted from multiple fire occurrence episodes (Carlton, 1995).

Expected fire behavior was generated using the Forest Service's ROSBYFIL program, which also resides at the Kansas City Computer Center. The IAA model was run with these fire behavior estimates for each of the 49 extended NFDRS fuel models described in Appendix A. The 49 extended NFDRS models were subsequently matched to the 188 FCCs evaluated in FETM. The output from the IAA consists of tables showing the proportion of fire exceeding the following seven size classes:

- A = less than 0.25 acre
- B = 0.25 to 9.9 acres
- C = 10 to 99.9 acres
- D = 100 to 299 acres
- E = 300 to 999 acres
- F = 1,000 to 4,999 acres
- G = 5,000+ acres

To determine the probability that a fire will exceed the 10-acre threshold size, the model computes the difference of 1 minus the cumulative frequency of 0- to 9.9-acre fires. The IAA model runs were performed by Don Carlton, Fire Protection Planning Specialist and Fire

Behavior Analyst, USDA Forest Service Region 6. The probabilities that fires will exceed the 10-acre threshold size (by fuel condition class) are summarized in Section 3.6.

Final Wildfire Size (F_i)

In Equation 2-2, the final wildfire size vector F_i is the area-weighted average of the *potential wildfire* sizes calculated for each of the 188 FCCs in the model:

$$F_i = o_i \sum_{j=1}^{N} s_{i,j} \; d_j \qquad (2\text{-}4)$$

where

o_i = area-weighted-average fire frequency (number of fires/year) in the ith fire weather class;

$s_{i,j}$ = m x n matrix of *potential wildfire* sizes by fuel condition class, each element of which represents the potential size of a fire burning homogeneously within the jth fuel condition class under the ith fire weather condition;

d_j = column vector representing the fractional distribution of acres in each of j fuel condition classes (j = 1, 2, 3,...,188), computed at the beginning of each simulation time step;

N = total number of fuel condition classes (188).

The *potential wildfire* size is defined as the fire size that would result if fires were allowed to burn uniformly and continuously within a fuel model on average terrain and under a specified set of meteorological conditions. In this study, the potential wildfire sizes ($s_{i,j}$ in Equation 2-4) were computed in one of two ways depending on whether the FCC- and fire-weather-dependent rate of spread was less than or greater than a "threshold" rate of spread. The threshold rate of spread was determined using historical data and is associated with a 30,000-acre fire. The large-fire threshold of 30,000 acres was based on fire behavior data obtained from recent wildfires on the nine Columbia River Basin National Forests (Carlton, 1995a). The methods used to calculate potential wildfire size within each of these regimes is described below.

Fire Spread Rate Less Than Threshold Value

For FCCs with fire spread rates less than the spread rate required to produce a 30,000-acre fire (threshold values are presented later), the potential wildfire size ($s_{i,j}$ in Equation 2-4) was computed using an analytical expression for fire size (acres) as a function of the wildfire *rate of spread* (ROS in chains/hour). Predictive equations were developed for four different fuel types–timber litter, slash, grass, and brush–each possessing distinctly different patterns of fire behavior due to flame lengths and difficulty of suppression. The predictive equations were based on a least-squares regression analysis of wildfire ROS and resultant fire size data for

the interior Columbia River Basin. The data needed to perform the regression analysis were obtained from different sources:

Controlled Fires Less Than 1,000 Acres. Data on wildfire ROS and resultant fire sizes for "controlled" fires (i.e., less than 1,000 acres in the Forest-calibrated IAA model runs) was produced using the Forest Service's IAA model. Input to the IAA consisted of the 50th and 90th percentile ROSs from the pcFIRDAT model, with primary output being the estimated fire size if the fire is controlled at less than 1,000 acres. All other inputs and assumptions were the same as described in "Area-Weighted-Average Fire Frequency" above. The results are shown in Table 2-1.

Uncontrolled Fires Between 1,000 Acres and 30,000 Acres. Data on the relationship between wildfire ROS and uncontrolled fire sizes between 1,000 acres and 30,000 acres was obtained from a conventional elliptical fire growth model (USDA Forest Service, 1990) based on observations of final fire size, fire duration, and estimated spread rates by Carlton (1995a) from fires burning in a manner consistent with the assumptions of this model. The fire growth model expresses fire size as a function of fire spread rate, elapsed time of spread, and a dimensionless area factor:

$$A = K\,(R \times T)^2 \qquad (2\text{-}5)$$

where

A = fire size (acres)
K = area factor (acres/chain^2)– determined from Table 2-2
R = fire spread rate (chains/hour)
T = time of active fire spread (hours)

Several recent wildfires were chosen to calibrate the equation (that is, to determine the appropriate area factor, K: the 13,000-acre Paulina Fire on the Deschutes National Forest, the 23,000-acre Canal Fire on the Wallowa-Whitman National Forest, and the 30,000-acre Lone Pine Fire on the Winema National Forest. These fires were chosen because of their size (between 1,000 acres and 30,000 acres) and because they roughly exhibited the elliptical growth pattern assumed in Equation 2-5.

The observed fire duration (T), fire size (A), and fire spread rate (R) from each fire were used to determine the factor K that produces the best fit to the data. The best fit was found with a factor of K=0.03. This factor was then applied to an independent fire data set for which T and either A or R were available to determine the relationship between A and R. Output from the analysis included the estimated ROSs and uncontrolled fire sizes between 1,000 acres and 30,000 acres. The results are shown in Table 2-3.

Table 2-1
IAA-Generated Fire Rates of Spread and Resultant Fire Sizes for Controlled Fires Less Than 1,000 Acres

Grass			Shrubs			Timber Litter			Slash		
FM	**ROS**	**Size**	**FM**	**ROS**	**Size**	**FM**	**ROS**	**Size**	**FM**	**ROS**	**Size**
AL1	1.7	0.1	FFF	3.4	0.6	GGG	2.1	0.3	JL1	0.6	0.1
AL1	6.4	2.0	FFF	4.7	1.0	GGG	2.9	0.4	JL1	1.6	2.0
AL2	1.7	0.1	FFF	7.4	9.0	GGG	3.2	0.5	JL1	2.6	0.4
AL2	9.4	4.0	FM1	2.9	0.4	GGG	4.4	1.0	JL1	3.5	0.6
CCC	4.5	1.0	FM1	4.3	0.9	GGG	4.8	0.7	JL1	4.1	0.6
CCC	7.6	2.7	FM1	4.5	1.0	GH1	0.8	0.1	JL1	5.6	4.0
CCC	16.0	26.0	TTT	2.5	3.0	GH1	3.6	0.6	JL1	9.0	24.0
CCC	16.4	28.0	TTT	11.8	8.0	GH1	4.2	0.8	JL2	0.6	0.1
CCC	2.8	0.3	TTT	15.3	21.0	GH1	5.0	1.2	JL2	1.6	2.7
CCC	5.7	1.5	TTT	18.5	52.0	GH1	8.3	11.0	JL2	3.4	0.6
CH1	4.1	0.8				GH1	9.9	25.0	JL2	4.0	0.8
CH1	2.8	0.3				GH1	6.5	5.0	JL2	6.5	6.7
CH1	5.8	1.6				GH1	13.6	213.0	JL2	9.3	31.0
CH1	7.8	2.8				GM1	2.2	0.2	JL3	4.0	0.8
CH1	17.3	35.0				GM1	3.0	0.4	JL3	4.9	1.1
CH1	20.6	67.0				GM1	3.8	0.7	JL3	5.6	1.1
CL1	1.7	0.1				GM1	4.9	1.1	JL3	7.7	9.7
CL1	3.3	0.5				GM1	6.1	3.5	JL3	9.3	31.0
CL1	7.5	2.6				GM1	7.6	9.1	JL4	6.3	6.2
CL1	8.5	3.4				GM1	11.7	51.0	JL4	7.8	9.6
CL2	2.9	0.3				HL1	0.6	0.1	JL4	9.1	22.0
CL2	5.0	1.2				HL1	1.2	0.1	JL4	11.2	47.0
CL2	7.0	2.2				HL2	2.8	0.4	JM2	6.1	5.5
CL2	11.8	8.0				HL2	3.7	0.7	JM2	8.5	16.9
CM1	4.4	0.9				HL3	3.6	0.6	JM2	10.1	65.0
CM1	2.7	0.3				HL3	5.3	1.3	JM2	11.1	60.0
CM1	5.6	1.5				HM1	1.8	0.2	JM3	7.2	8.1
CM1	7.2	2.4				HM1	3.0	0.4	JM3	9.0	21.0
AAA	13.8	11.0				UUU	2.0	0.2	KH4	16.1	151.0
LLL	3.7	0.7				UUU	1.5	0.1	KM5	13.8	57.0
LLL	13.3	10.0				UUU	2.5	0.3	KM5	15.3	91.0
LLL	23.6	88.0				UUU	3.0	0.4	KM6	15.5	103.0
LLL	38.8	718.0									
NNN	1.7	0.2									
NNN	8.7	12.0									

FM = Extended NFDRS fuel model
ROS = Rate of spread (chains/hour)
Size = Fire size (acres)

Table 2-2 Area Factor as Function of 20-Foot Windspeed	
20-Foot Wind Speed (mph)	**Area Factor (K)**
1	0.115
2	0.100
3	0.085
4	0.070
5	0.060
6	0.054
7	0.047
8	0.042
9	0.038
10	0.032
11	0.029
12	0.026
13	0.022
14	0.019
15	0.018
Source: Carlton (1995a)	

Table 2-3
Deduced Fire Rates of Spread and Resultant Fire Sizes for Uncontrolled Fires Between 1,000 Acres and 30,000 Acres

Grass			Shrubs			Timber Litter			Slash		
T	**R**	**A**	**T**	**R**	**A**	**T**	**R**	**A**	**T**	**R**	**A**
4	55	1,500	8	24	3,300	12	16	1,100	12	20	1,700
6	70	5,300	12	32	4,400	12	20	1,700	18	24	5,600
8	82	13,000	16	41	13,000	18	24	5,600	25	27	13,000
8	100	23,000	16	55	23,000	25	27	13,000	25	32	23,000
8	125	30,000	16	62	30,000	25	32	23,000	25	40	30,000
						25	40	30,000			

T = Fire duration (hours)
R = Fire rate of spread (chains/hour)
A = Fire size (acres)

The final fire sizes and spread rates for both controlled and uncontrolled fires were then used as input to the regression analysis. The data were transformed using a log function, then fit using either a 3rd- or 4th-order polynomial equation. Separate curves were fit to the timber litter, slash, grass, and shrub data. These curves, and the predictive equations corresponding to each, are illustrated in Figures 2-1 through 2-4.

The rate of spread required to produce a fire greater than the 30,000-acre threshold size varies by vegetation type. For timber litter and slash models, the threshold ROS is 40 chains per hour. However, the model uses a threshold ROS of 35 chains per hour because the regression equation results in decreasing fire sizes with increasing fire spread rates above 35 chains per hour. For shrub models, the threshold ROS is 62 chains per hour. For grass, the threshold ROS is 125 chains per hour.

Spread Rates Greater Than Threshold Value

For FCCs with fire spread rates greater than the spread rate required to produce a 30,000-acre fire,. the potential wildfire size was determined by random selection from a uniform probability distribution. The distribution was assumed to range from 30,000 acres to 1,000,000 acres. The upper limit of the range was set based on the maximum theoretical fire size that could be produced by a fire burning under homogeneous conditions within a single fuel model. The same upper limit was applied to all four major vegetation types.

2.2.3 Wildfire Emissions Algorithm

Wildfire emissions (E_w; pounds per year) are estimated based on several factors: wildfire acres burned per year by FCC and fire weather class, fuel consumption by FCC and fire weather class (including foliage mass for crown fires), and emission factors by FCC. This is expressed in the following equation:

$$E_w = \sum_{i=1}^{3} \sum_{j=1}^{188} F_i \; d_j \; c_{i,j} \; e_j \qquad (2\text{-}6)$$

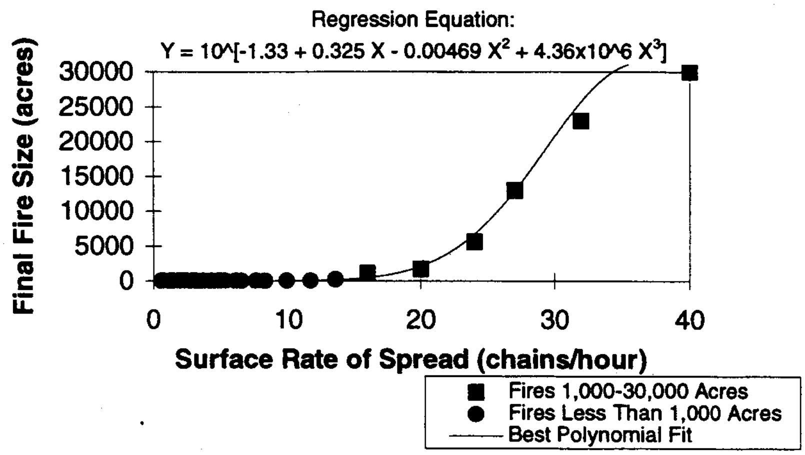

Figure 2-1. Potential Fire Size Versus Fire Rate of Spread–Timber Litter Fuel Models

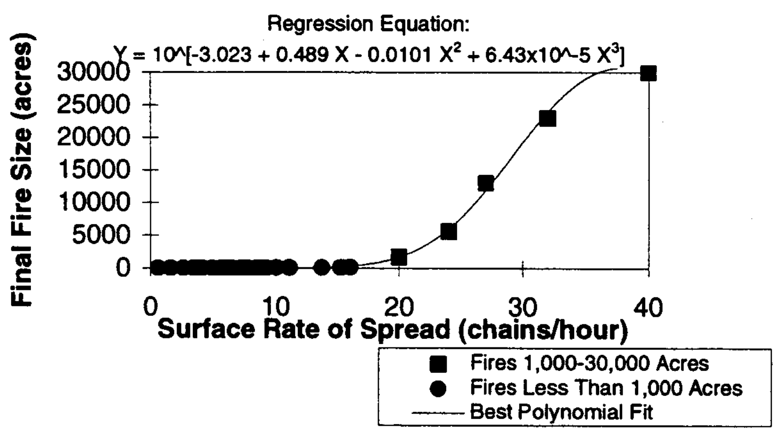

Figure 2-2. Potential Fire Size Versus Fire Rate of Spread–Slash Fuel Models

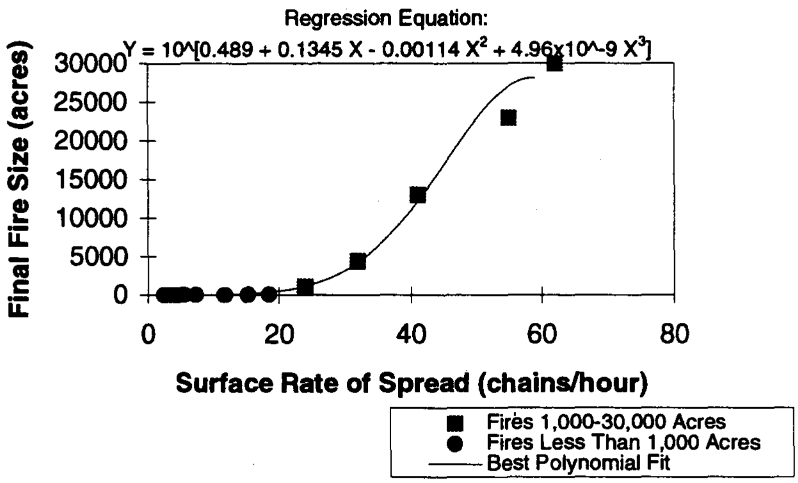

Figure 2-3. Potential Fire Size Versus Fire Rate of Spread–Shrub Fuel Models

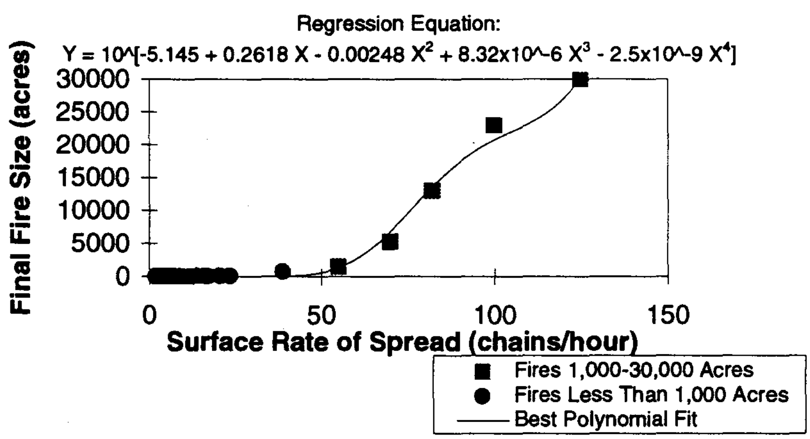

Figure 2-4. Potential Fire Size Versus Fire Rate of Spread–Grass Fuel Models

where

F_i = final wildfire acreage burned in the ith fire weather class (i = 1, 2, 3) (acres);

d_j = fractional distribution of acres in each of j fuel condition classes (j = 1, 2, 3,...,188), computed at the beginning of each simulation time step (dimensionless);

$c_{i,j}$ = wildfire fuel consumption for the jth fuel condition class (j = 1, 2, 3,...,188) and the ith fire weather class (i = 1, 2, 3), computed at the beginning of each simulation time step (tons per acre);

e_j = wildfire emission factor for the jth fuel condition class (j = 1, 2, 3,...,188) (pounds of PM_{10} per ton of fuel consumed);

The wildfire acreage by FCC and fire weather class was obtained by distributing the final wildfire size by fire weather class (F_i in equation 2-5) by the acreage distribution vector (d_j). The fuel consumption estimates were obtained using the CONSUME model (see Section 3.7). The fuel-specific wildfire emission factors were obtained from the scientific literature (see Section 3.8).

2.2.4 Prescribed Fire Emissions Algorithm

Prescribed fire emissions (E_P; pounds per year) are estimated based on the number of prescribed-fire acres burned per year by FCC, fuel consumption by FCC, and emission factors by FCC:

$$E_P = \sum_{j=1}^{188} P_j \; c_j \; e_j \tag{2-7}$$

where

P_j = Prescribed-fire acreage burned in the jth fuel condition class (j = 1, 2, 3, ..., 188) (acres);

c_j = prescribed-fire fuel consumption for the jth fuel condition class (j = 1, 2, 3,...,188), computed at the beginning of each simulation time step (tons per acre);

e_j = prescribed-fire emission factor for the jth fuel condition class (j = 1, 2, 3,...,188) (pounds of PM_{10} per ton of fuel consumed);

The prescribed-fire acreage burned per year by FCC class was obtained from the sum of the off-diagonal elements in each *column* of the prescribed fire transition matrix (see Section 3.4.3). The fuel consumption estimates for prescribed fire were obtained using the CONSUME model (see Section 3.7). The fuel-specific wildfire emission factors were obtained from the scientific literature (see Section 3.8).

Chapter 3
Model Inputs and Assumptions

This chapter summarizes the modeling inputs and assumptions used to simulate changes in the acreage distribution, wildfire sizes and frequency, and fire emissions over time within the Grande Ronde River Basin. The following inputs are discussed:

- Fuel condition classes (FCCs) used to represent the current and future acreage distribution within the study area
- Existing fuel conditions within the study area
- Current acreage distribution within the study area
- Transition matrices used to represent changes in fuel loading and structure over time within the study area
- Wildfire spread rates, including allowance for additional spread rates due to crowning
- Historical wildfire frequency within study area
- Fuel consumption rates within study area
- Fire emission factors for fuel types found within the study area

The FETM inputs are listed in tables that are either inserted in the text (short tables) or collected in Appendix B (long tables). In-text references indicate each table's location.

A team of experts from Region 6, the Pacific Northwest Research Station, and CH2M HILL was used to assemble and analyze these data and to assess their appropriateness for modeling fire and fuel conditions within the Grande Ronde River Basin (see Acknowledgements). While the data presented in this chapter apply only to the Grande Ronde River Basin, the methods that are used may be exported to other watershed basins and regions within the western United States.

3.1 Fuel Condition Classes in the Grande Ronde River Basin

In FETM, the fuel loading across the landscape is characterized in terms of the number of acres contained in different *fuel condition classes* (FCCs). Each FCC represents a unique combination of vegetation type, age class, loading class, and activity class (Table 3-1).

The vegetation types listed in Table 3-1 were chosen based on the predominant vegetation types observed in recent aerial photographs of 10 sample watersheds (approximately 240,000 acres) in the Grande Ronde River Basin.

Each of the nine vegetation types was further separated into a maximum of four age classes. In FETM, age classes are used as a coarse surrogate for structural stages. The range of stand ages for each of the three age classes varies by vegetation type (Table 3-2).

The resulting combinations of vegetation type/age class were further separated into three loading classes: low, medium, and high. The range of fuel loadings represented in each loading class also varied by vegetation type. For example, low loading in ponderosa pine is much greater than high loading in grass.

The activity classes listed in Table 3-1 were chosen based on management practices that are currently used on the Umatilla National Forest and Wallowa-Whitman National Forest.

A total of 188 FCCs are included in the current version of FETM (Table B-1). These FCCs include 70 natural-stand (no activity) FCCs and 118 managed-stand FCCs.

3.2 Existing Fuel Conditions in the Grande Ronde River Basin

Current fuel conditions within the Grande Ronde River Basin were estimated using satellite imagery and stand examination data for 10 sample watersheds representing approximately 20 percent of the area (approximately 240,000 acres) within the Grande Ronde River Basin. Detailed satellite photographs were first used to map the watersheds in terms of major vegetation types and structural (age) classes. The data for discrete areas (polygons) were then compared to stand examination data. The stand examination data provided refinements to the vegetation composition and structural class descriptions, as well as additional information such as quadratic-mean stand diameter, stand density, and basal area. These descriptions were then matched with the closest situation represented in one of several published photographic series, including General Technical Report PNW-52 (Maxwell and Ward, 1976) and General Technical Report PNW-105 (Maxwell and Ward, 1980). A team of fuel specialists and fire managers from the Wallowa-Whitman and Umatilla National Forests (see Acknowledgements) was then convened to evaluate the resulting fuel profiles assigned to each FCC. Changes were made after a consensus was reached among all team members.

Fuel loadings were determined for the 1-hour (0 to 1/4-inch), 10-hour (1/4- to 1-inch), 100-hour (1- to 3-inch), 1,000-hour (3- to 8-inch), 10,000-hour (8- to 20-inch), and greater than 10,000-hour (> 20-inch) dead-and-down woody fuels for each FCC (Table B-2). A forest floor depth was also assigned to each FCC. Fifty percent of the forest floor depth was assumed to be litter, with the remaining depth assigned to duff. Duff and litter depths were converted to loading (tons per acre) using a bulk density of 12.1 tons per acre per inch for duff and 3.0 tons per acre per inch for litter.

Table 3-1 Options in FETM for Characterizing Fuel Condition Classes	
Descriptor	**Option**
Vegetation Type	Ponderosa pine (seral type) Mixed conifer Lodgepole pine (climax type) Western juniper Grass (stable community) Grass/ponderosa pine (grass succeeding to ponderosa pine) Grass/lodgepole pine (grass succeeding to lodgepole pine) Shrub (stable community) Shrub/mixed conifer (shrub succeeding to mixed conifer)
Age Class	Bare ground Immature Mature Overmature
Loading Class	Low Medium High
Activity Class	No activity (natural stands) Precommercial thin, lop and scatter slash Precommercial thin, pile and burn slash Precommercial or commercial thin, no mechanical treatment Commercial thin, crush slash Commercial thin, pile and burn slash Final harvest (logged), no mechanical treatment Final harvest (logged), yard unmerchantable material Final harvest (logged), yard to landing with tops attached

Table 3-2
Ranges Used to Describe Age Classes

Vegetation Type	Stand Age (Years Since Disturbance)[1]			
	Bare Ground	**Immature**	**Mature**	**Overmature**
Ponderosa Pine	0	40	90	190
Mixed Conifer	0	25	95	175
Lodgepole Pine	0	15	65	95
Western Juniper	0	40	60	—
Grass	0	5	10	—
Shrubs	0	1	2	—

[1] Starting age for each age class

3.3 Existing Acreage Distribution in the Grande Ronde River Basin

3.3.1 Approach

The data required to apportion the number of acres by FCC within the Grande Ronde River Basin were obtained from vegetation maps and patch (i.e., small area) attributes developed for the Eastside Forest Health Assessment (Lehmkuhl et al., 1994). Patches were described by several attributes, including species composition, stand structural class, and whether logging entry had occurred. Five structural classes were considered: seedling-sapling-pole, young, mature, mature park-like, and old forest.

These stand attributes were matched with the description (see Table B-1) for each of the 188 FCCs. In several cases, the stand attributes were not specific enough to relate to a single FCC. When this occurred, the acres were divided evenly among a group of closely related FCCs. For example, 12,000 acres were interpreted as *immature ponderosa pine with no logging entry*. Since the initial stand characterization did not include fuel loading class, the 12,000 acres were divided evenly into the low, medium, and high loading classes (4,000 acres per loading class).

3.3.2 Commercial versus Noncommercial Lands

FETM distinguishes commercial forestland–where utilization, mechanical treatment, and prescribed fire may be used to alter fuel loading and structure–from noncommercial forestland, where only prescribed fire may be used. All lands within the Grande Ronde River Basin were assumed to be commercial unless formally designated as Wilderness or within the boundaries of a Wild and Scenic River. The approximate number of acres within the Wenaha-Tucannon Wilderness Area, Eagle Cap Wilderness Area, and Grande Ronde Scenic River corridor was acquired from the Wallowa-Whitman and Umatilla National Forests. A planimeter was used to determine the area within these congressionally reserved lands that were *outside* the Grande Ronde River Basin, and this amount was subtracted from the total obtained from the National Forests.

The approximate land area within the study area portion of the Grande Ronde River Basin is 1,193,726 acres. Commercial lands within the study area occupy approximately 747,688 acres. Noncommercial lands within the study area occupy approximately 446,038 acres.

3.4 Transition Matrices Used in FETM

The transition matrices used in the modeling analysis were prepared using input from local specialists in silviculture, forest management, fuels, and fire management from the Wallowa-Whitman and Umatilla National Forests (see Acknowledgements). A 3-day meeting was convened at the Portland, Oregon International Airport during January 1994 to develop the initial matrices. Follow-up meetings were held in Portland and Pendleton, Oregon during February 1994 and June 1995 to refine the matrices based on the initial output from the

model. The sections that follow summarize the major assumptions used in developing the transition matrices. The matrices themselves are presented on diskettes in Appendix E.

3.4.1 Utilization

In FETM, "utilization" refers to final harvest activities, which include extraction of wood products for utilization in lumber, paper, and firewood. For ponderosa pine and mixed conifer stands within the Grande Ronde Basin, the preferred final harvest method is partial cutting. For lodgepole pine, the preferred final harvest method is clearcutting.

The transfer coefficients used in the matrices were selected based on the current rotation age for each forested vegetation type. For ponderosa pine, the rotation age is 300 years, so 0.33 percent of the total area contained in mature and overmature ponderosa pine is assumed to be harvested each year. For mixed conifer, the rotation age is 120 years, so 0.83 percent of the total area contained in mature and overmature mixed conifer is assumed to be harvested each year. For lodgepole pine, the rotation age is 80 years, so 1.25 percent of the total area contained in mature and overmature lodgepole pine is assumed to be harvested each year.

The initial modeling scenarios used to test FETM did not include utilization of western juniper, shrubs, or grass.

3.4.2 Mechanical Treatment

In FETM, "mechanical treatment" denotes non-fire methods of fuels treatment following intermediate and final harvest activities (e.g., crushing, machine- or hand-pile-and-no-burn, lopping and scattering, yarding unmerchantable material (YUM), yarding with tops attached). The area treated annually by mechanical methods was based on a treatment interval of 20 years for immature ponderosa pine (5 percent per year), 50 years for immature mixed conifer (2 percent per year), 50 years for immature lodgepole pine (2 percent per year), and 1 year for logging slash (100 percent per year).

No attempt was made to balance the number of acres *utilized* each year with the number of acres *mechanically treated* each year, although checks were made to ensure that the latter acreage was less than or equal to the former acreage.

The scenarios developed to test FETM did not include mechanical treatment of *natural* (or non-activity) fuels, but this capability could be added in future scenarios. The test scenarios assumed no harvest activities in the western juniper, shrub, or grass types, so no mechanical treatment is practiced in these vegetation types.

3.4.3 Prescribed Fire

In the current version of FETM, the number of acres consumed by prescribed fire is determined by the "level of prescribed fire treatment," a user entry. The user may assign from one to six levels of prescribed fire treatment. Each level represents the percentage of the total acreage available in *targeted FCCs* (described later) treated by prescribed fire each year. A 1 percent prescribed-fire treatment program means that 1 percent of the available

acreage in each of the targeted FCCs will be treated by prescribed fire each year. Prescribed fire is assumed to affect the fuel loading and structure over 100 percent of the burn area (that is, no untreated areas are allowed to exist within the burned areas).

In the initial testing of FETM, six prescribed-fire treatment levels were chosen: zero percent (no prescribed fire) 1 percent, 2 percent, 3 percent, 4 percent, and 5 percent of the total available acreage in targeted FCCs. The targeted FCCs included all those in which fire could reasonably be used according to fire managers for the Wallowa-Whitman and Umatilla National Forests. According to these fire managers, prescribed fire should be avoided in the following FCCs:

- Bare ponderosa pine, all loading classes (FCC 1-3)
- Immature ponderosa pine, natural stands, high loading only (FCC 6)
- Immature ponderosa pine, thinned stands without fuel treatment or those with fuel treatment by any mechanical treatment method except piling, all loading classes (FCC 17, FCC 19, FCC 20, FCC 22, FCC 24, FCC 25, FCC 27)
- Bare mixed conifer, all loading classes (FCC 52-54)
- Immature mixed conifer, natural stands, all loading classes (FCC 55-57)
- Mature mixed conifer, natural stands, all loading classes (FCC 58-60)
- Overmature mixed conifer, natural stands, medium and high loading classes (FCC 62, FCC 63)
- Immature mixed conifer, thinned stands without fuel treatment or those with fuel treatment by any mechanical treatment method except piling, all loading classes (FCC 65, FCC 66, FCC 68, FCC 70, FCC 71, FCC 73, FCC 75, FCC 76, FCC 78)
- Mature mixed conifer, logged stands with or without any fuel treatment except YUM, high loading classes (FCC 87-89)
- Overmature mixed conifer, logged stands with or without any fuel treatment except YUM, medium and high loading classes (FCC 95-97, FCC 99-101)
- Lodgepole pine, natural stands, all age and loading classes (FCC 103-114)
- Immature lodgepole pine, thinned stands with fuels treatment by any mechanical method except piling, all loading classes (FCC 116, FCC 117, FCC 119, FCC 121, FCC 122, FCC 124, FCC 126, FCC 127, FCC 129)
- Mature lodgepole pine, logged stands with or without fuel treatment except YUM, all loading classes (FCC 130-132, FCC 134-136, FCC 138-140)

- Overmature lodgepole pine, logged stands with or without fuel treatment except YUM, all loading classes (FCC 142-144, FCC 146-148, FCC 150-152)

- Grass or grass with ponderosa pine or lodgepole pine regeneration, low fuel loading (FCC 163-165)

- Grass with lodgepole pine regeneration, medium and high fuel loading (FCC 168, FCC 171)

- All shrub types, all loading classes (FCC 172-183)

- Immature lodgepole pine, very low fuel loading (FCC 188)

3.4.4 Wildfire

Unlike the other transition matrices, the wildfire matrix is purely an *effects* matrix. It contains the rules for specifying how the vegetation type and fuel loading change in response to wildfire, but does not contain the rules for determining the number of acres burned by wildfire each year. The number of acres consumed by wildfire each year is calculated in Equation 2-5.

3.4.5 Natural Succession

In FETM, the rate at which acres move along different successional stages is the inverse of the time span allocated to each stage. The number of years between successional stages may be calculated from the information presented in Table 3-2 (above).

3.5 Fire Spread Rates

The FETM model requires detailed information on the spread component (i.e., relative measure of fire spread, measured in units of chains per hour) *in surface fuels* by FCC and fire weather class. It also requires a series of constants to adjust the surface-fire spread components to reflect the spread components of fires burning through the crowns. The methods used to compute the surface-fire spread rates and crowning potential are described below.

3.5.1 Spread Rates for Surface Fires

FETM requires the user to input a 188 x 3 matrix of spread components (188 FCCs, 3 fire weather classes), which are used to compute the potential wildfire sizes described in Chapter 3. The matrix was populated with values computed using the California Division of Forestry's pcFIRDAT program (CDF, 1994). Spread rate was determined from the spread component (SC), which was computed for each of the 49 extended NFDRS fuel models described in Chapter 2. These spread rates were subsequently matched to the 188 FCCs used in the current version of FETM. FETM automatically converts the SC (feet/minute) to ROS (chains/hour) for the fire size calculations described in Chapter 2.

The methods and assumptions used to compute the surface-fire spread components are described in Appendix A. The matrix of spread components used is presented in Table B-3.

3.5.2 Spread Rates for Crown Fires

For crown fires, the spread rates were determined by scaling the surface spread rate by the average ratio of the crown-fire ROS to the surface-fire ROS. Following Rothermel's (1983) guidance, the crown-fire ROS was shown to be 3.3 times the rate of spread predicted for fire behavior fuel model 10. Ratios of the crown to ground ROS were determined separately for each of the 49 extended NFDRS fuel models represented in the FETM model.

Determination of Crown Fire Potential

Prior to adjusting the surface-fire spread components, FETM determines whether a crown fire is likely for each combination of FCC and fire weather class. The investigative team developing the fire behavior portions of the model (see Acknowledgements) proposed two criteria for evaluating the crowning potential of fires. A fire would be expected to crown if either of the following conditions are met:

1. The stand density is greater than 100 stems per acre, and the spread rate for surface fuels is greater than the *critical* spread rate required for crowning. [Note: Future versions of FETM may consider the use of a crown closure parameter rather than tree density.]

2. The energy release component (ERC) for surface fuels is greater than the critical energy release component required for crowning.

The methods used to determine each of these components are described below.

Critical Spread Rate

Theory

The critical spread rate required for crowning was computed based on work by Van Wagner (1977) and Alexander (date unknown) correlating the critical flame length at which crowning can be expected to occur to foliar moisture content and the height to the base of live crowns of trees. The development of the critical spread components is summarized below.

The NFDRS burning index (BI) is related to flame length (F_L; feet) by the following equation:

$$BI \cong 10\left(F_L\right) \qquad (3\text{-}1)$$

Flame length is also related to Byram's critical fireline intensity for crowning (I_0; Btu/feet/second) by the following equation (Albini, 1976):

$$F_L = 0.45\,(I_0)^{0.46} \tag{3-2}$$

Byram's critical fireline intensity for crowning is related to the height to the base of the live crown (z_0; feet) and foliar moisture content (m; percent), as follows:

$$I_0 = [(0.0030976)(z_0)(197.9 + 11.186m)]^{1.5} \tag{3-3}$$

By substitution,

$$BI = 4.5\,[(0.0030976)(z_0)(197.9 + 11.186m)]^{0.69} \tag{3-4}$$

If the relationship between the BI and SC is known, the critical SC may be computed as a function of the BI:

$$SC = f(BI) = f(4.5\,[(0.0030976)(z_0)(197.9 + 11.186m)]^{0.69}) \tag{3-5}$$

This is the equation used to calculate the critical spread component required for crowning as a function of the height to the base of the ladder fuels, and the foliar moisture content. Spread component is easily converted to ROS by the following equation:

$$ROS \cong 0.9 \bullet SC \tag{3-6}$$

Calculation of Critical Spread Components

The functional relationship between the SC and BI was determined by a least-squared fit of data (both SC and BI) obtained from the pcFIRDAT runs performed on the 49 extended NFDRS models described in Appendix A. A second-order polynomial equation was used to fit the curves to the data points.

The height to base of the *ladder* fuels (discussed later in this section) for each FCC was determined using data published in the natural-stand photo series by Maxwell and Ward (1980) (see Appendix A). For some FCCs, adjustments were necessary to more accurately reflect the conditions of overstocking and stagnant understory development that currently exist within many parts of the study area.

The foliar moisture content (m) for all forest types was assumed to be 105 percent.

Fuels specialists from the Umatilla and Wallowa-Whitman National Forests have observed that, in many stands within the study area, significant dead fuels are present within the live crowns of trees and at a much greater height than the dead ladder fuels below the live crown. After discussions with Marty Alexander (Carlton, 1995b), it was determined that the use of the height to the base of the *ladder fuels* (dead or alive) rather than the height to the base of the *live crown* was appropriate and produced a conservative estimate of the critical flame length required for crowning. This conclusion is based on the observation that if both dead and live fuels will burn in the crowns at the critical flame length, then the dead fuels below the crowns can also be expected to burn at the critical flame length.

Appendix D, Table D-1, contains a listing of FCCs, their ladder fuel heights and stand densities, and calculated critical spread components and energy release components required for crowning.

Critical Energy Release Component

Once the critical spread component was determined for each FCC, the determination of the critical ERC was relatively simple using the following expression (Carlton, 1995):

$$BI = f(SC) = 3(SC * ERC)^{0.46} \qquad (3\text{-}7)$$

where the functional relationship between burning index and spread component is the same as that described above. This can be rewritten to express ERC as a function of SC.

A listing of the critical ERC values by FCC is presented in Table D-1.

Tree Density

Tree density by FCC was estimated using data from a published photographic series (Maxwell and Ward, 1980). In addition to determining crowning potential, tree density is used to determine crown mass, which is a critical variable in determining crown mass consumption and its contribution to smoke emissions during wildfires (see Section 3.7.2).

The Maxwell and Ward (1980) photographic series contains tree densities (i.e., number of trees per acre) by size class. Tree densities were determined for each combination of vegetation type and age class. Prior to the analysis, the photographic series data were stratified by forest type and size class. The forest types included Douglas-fir/hardwood, subalpine fir, mixed conifer, lodgepole pine, ponderosa pine/associated species, ponderosa pine, brush, western juniper, and grass. The size classes included <5 inches diameter at breast height (dbh; roughly 4.5 feet above ground), 5 to 11 inches dbh, 11 to 20 inches dbh, and >20 inches dbh.

In selecting the appropriate tree density for each of the 188 FCCs, an assumption was made that the ponderosa pine FCCs would be matched with data from the ponderosa pine/associated species and ponderosa pine forest types; the mixed conifer FCCs would be matched with data from the mixed conifer and subalpine fir forest types; and the lodgepole pine FCCs would be matched with data from the lodgepole pine and western juniper forest types. An assumption was also made that the <5-inch dbh size class would represent the "immature" age class, the 5- to 11-inch dbh and 11- to 20-inch dbh size classes would represent the "mature" age class, and the >20-inch dbh size class would represent the "overmature" age class for all FCCs.

If multiple pages from the photographic series were representative of a single vegetation type/age class combination, then the tree densities from all representative pages were summed and averaged.

A listing of the stand density values by FCC is presented in Table D-1.

3.6 Historical Wildfire Frequency for Grande Ronde River Basin

In FETM, wildfire frequency (i.e., number of fires per year) is treated as a random variable, with values selected from Poisson probability distributions for each of three NFDRS fire weather classes: high, very high, and extreme. The means of the three Poisson distributions (required input to the Poisson random-number generator) were calculated based on a total frequency of fires obtained from historical records for the area, weighted by the fraction of time occupied in each of the three fire weather classes during a typical fire season (June 15-September 30). Historical records from nine eastside National Forests (1970-1992) show that the total frequency of wildfires greater than 0.25 acre in size, scaled to the area of the Grande Ronde River Basin (approximately 1,193,726 acres), was approximately 109 fires per year (Table 3-3).

The mean number of fires by fire weather class was then determined by multiplying the total frequency of wildfires greater than 0.25 acre (109 fires/year) by the percentage of time occupied in each of the three fire weather classes. The latter was determined *a priori* using the cumulative frequency distributions of the *NFDRS spread component* for the FCCs characterized within the Grande Ronde River Basin. The spread component integrates the effects of wind, slope, and fuel bed and fuel particle properties to predict the forward rate of fire line expansion, with units of spread component (Rothermel, 1972; Albini, 1976a, 1976b). Three percentile ranges of the spread component were used in the model to characterize the three fire weather classes. For extreme fire weather, the 98th through 100th percentile spread components were used. For very high fire weather, the 90th through 98th percentile spread components were used. And for high fire weather, the 40th through 90th percentile values were used. These ranges approximate the vertical-slope region of the upper "S" bend of the sigmoidal cumulative frequency distribution, the "breaking region" on the upper "S" bend of the distribution, and the constant slope region between the upper and lower "S" bends of the distribution. The difference between the upper and lower end of the ranges suggests that 50 percent of the time the fire weather is classified as "high" fire danger (i.e., 90-40 = 50), 8 percent of the time it is classified as "very high", and 2 percent of the time it is classified as "extreme."

Multiplying these percentages by 109 fires per year (see Table 3-3) yields a mean frequency of about 55 fires per year for the high fire weather class, about 9 fires per year for the very high fire weather class, and about 2 fires per year for the extreme fire weather class. These are the initial frequencies entered into the model (T_i in Equation 2-3). According to Equation 2-3, the mean frequencies of the Poisson distributions (o_i) were determined by multiplying T_i by the sum of the *probabilities* that fires burning uniformly in each FCC would exceed the 10-acre threshold size (see next section), weighted by the fraction of area contained in each FCC at the beginning of the simulation time period.

Table 3-3 Historical Fire Frequency on Nine Columbia River Basin National Forests[1]			
National Forest	**National Forest Acreage**	**Wildfire Frequency (#)[2]**	**Normalized Fire Frequency (#)[3]**
Deschutes	1,605,000	177	110
Fremont	1,201,000	97	81
Malheur	1,465,000	148	101
Ochoco	848,000	109	128
Wallowa-Whitman	2,264,000	163	72
Umatilla	1,406,000	136	97
Wenatchee	1,672,000	167	100
Boise	2,648,000	180	68
Payette	2,323,000	146	63
Nine-Forest Average	*1,714,666*	—	*91*
Grande Ronde River Basin	***1,193,726***	***109***	—

[1] Unpublished data from Don Carlton, USDA Forest Service, Region 6, Portland, Oregon (March, 1994); period from 1970-1992
[2] For fires greater than 0.25 acres in size
[3] Number of fires per 1,000,000 acres

The probabilities that fires will exceed a 10-acre threshold size were determined through multiple runs of the IAA model using the 49 extended NFDRS fuel models described in Wildfire Frequency (o_i) (Section 2.2.2). Table 3-4 summarizes the probabilities of fires greater than the 10-acre threshold for each of the 49 extended NFDRS models. Table 3-5 summarizes the probabilities by FCC number.

Table 3-4
Proportion of Fires Greater Than 10-Acre Threshold Size[1]–by Extended NFDRS Fuel Model

Extended NFDRS Fuel Model	Proportion of Fires Greater Than 10 Acres	Extended NFDRS Fuel Model	Proportion of Fires Greater Than 10 Acres
AL1	0	KL3	0
AL2	0.0025	KL4	0.0049
CL1	0	KM1	0
CL2	0.0074	KM2	0
CM1	0	KM3	0.1263
CH1	0.0026	KM4	0.0373
FM1	0.1801	KM5	0.0762
GM1	0.0572	KM6	0.3880
GH1	0.1150	KH1	0.0211
HL1	0	KH2	0.1862
HL2	0	KH3	0.0074
HL3	0	KH4	0.1813
HM1	0	LL1	0.0025
HM2	0	LL2	0.0752
HH1	0	SH1	0
HH2	0.0002	TL1	0.0022
JL1	0.2147	TM1	0.0133
JL2	0.3867	TM2	0.0693
JL3	0.3681	TM3	0.2015
JL4	0.5946	TH1	0.0342
JM1	0.2179	TH2	0.2566
JM2	0.6725	UL1	0
JM3	0.8226	UL2	0
KL1	0	UM1	0
KL2	0		

[1] Based on IAA model runs for 49 extended NFDRS fuel models and generic fire organization at MEL minus 20%

Table 3-5 Proportion of Fires Exceeding the 10-Acre Threshold Size[1]–by FCC Number									
FCC	Proportion	FCC	Proportion	FCC	Proportion	FCC	Proportion	FCC	Proportion
1	0	41	0.0762	81	0	121	0	161	0.2566
2	0	42	0	82	0.0762	122	0.0074	162	0.2566
3	0	43	0.0762	83	0.0373	123	0	163	0.0025
4	0	44	0.0373	84	0.0373	124	0	164	0
5	0	45	0.0373	85	0	125	0	165	0
6	0.0026	46	0	86	0.0762	126	0.2147	166	0.0752
7	0	47	0.0373	87	0.1813	127	0.3681	167	0
8	0	48	0.3880	88	0.1813	128	0	168	0
9	0	49	0.3880	89	0	129	0.2147	169	0.0752
10	0.0133	50	0.0049	90	0.1813	130	0.3880	170	0
11	0	51	0.1813	91	0.0762	131	0.3880	171	0
12	0	52	0	92	0.0762	132	0.0049	172	0.1801
13	0	53	0	93	0.0762	133	0.3880	173	0.1801
14	0	54	0	94	0	134	0.0373	174	0.1801
15	0	55	0	95	0.1813	135	0.0373	175	0.1801
16	0	56	0	96	0.1813	136	0	176	0.1801
17	0	57	0	97	0.1813	137	0.0373	177	0.1801
18	0	58	0	98	0	138	0.0074	178	0.0342
19	0.2147	59	0	99	0.1813	139	0.0074	179	0.0133
20	0.3681	60	0	100	0.1813	140	0	180	0.0342
21	0	61	0	101	0.1813	141	0.0074	181	0.0342
22	0.2147	62	0	102	0	142	0.0373	182	0.0133
23	0	63	0.0572	103	0	143	0.0373	183	0.0342
24	0.2147	64	0	104	0	144	0	184	0.0693
25	0.3681	65	0	105	0.0002	145	0.0373	185	0
26	0	66	0.0373	106	0	146	0.0373	186	0
27	0.	67	0	107	0.0572	147	0.0373	187	0
28	0.0762	68	0	108	0.1150	148	0	188	0
29	0.0762	69	0	109	0	149	0.0373		
30	0	70	0.2147	110	0.0572	150	0.0074		
31	0.0373	71	0.6725	111	0.0572	151	0.0074		
32	0.0762	72	0	112	0	152	0		
33	0.0762	73	0	113	0	153	0.0074		
34	0	74	0	114	0.0572	154	0.2015		
35	0.0762	75	0.2147	115	0	155	0.2015		
36	0.5946	76	0.6725	116	0	156	0.2015		
37	0.5946	77	0	117	0	157	0.2015		
38	0.3887	78	0.2147	118	0	158	0.2015		
39	0.0762	79	0.8226	119	0	159	0.2015		
40	0.0762	80	0.8226	120	0	160	0.2566		

[1] Based on IAA model runs for 49 extended NFDRS fuel models and generic fire organization at MEL minus 20%

3.7 Fuel Consumption Estimates

3.7.1 Consumption of Dead-and-Down Fuels

The CONSUME model (Ottmar et al., 1993) was used to estimate fuel consumption under a variety of environmental conditions ranging from wet (simulating prescribed fire conditions) to dry (simulating wildfire conditions). For each of the 188 FCCs, the CONSUME model was run at eight 1,000-hour fuel moisture contents: at 6, 8, 10, 12, 18, 20, 30, and 40 percent fuel moisture. Fuel moisture contents of 12, 10, and 8 percent were chosen to simulate wildfire consumption under high, very high, and extreme NFDRS fire weather conditions, respectively. A fuel moisture content of 40 percent was used to simulate consumption by prescribed fire under low NFDRS fire weather conditions. The fuel consumption values used as input to FETM are presented in Table B-4.

3.7.2 Consumption of Crown Fuels

In FETM, crown fires are assumed to consume a portion of the live and dead crown mass, but primarily foliage and small branchlets. Crown mass (including foliage and branches up to 3 inches in diameter) was estimated using the relationships between crown weight and average stand diameter, crown length, tree height, and crown ratio developed by Brown (1978) for 11 Rocky Mountain conifer species. Data on overstory species, tree density, average stand diameter, and average tree height were obtained from the sources described in Section 3.6.1. The species reported by Brown (1978) did not include the mixed conifer or western juniper, both of which are needed in FETM. Therefore, grand fir was substituted for mixed conifer, and western red cedar was substituted for western juniper in the crown mass calculations. Crown mass was estimated separately for both natural stands and managed stands based on differences in tree density and average stand diameter.

Crown mass for individual trees was estimated for five crown-fuel size classes: foliage, foliage plus 0- to 0.24-inch branches, 0.25- to 0.99-inch branches, 1.00- to 2.99-inch branches, and greater than 3.00-inch branches. In this investigation, crown fires were assumed to consume 100 percent of the foliage (P1 in equations) and none of the live or dead branchwood (Ottmar, 1995). Complete consumption of the 0-to 0.24-inch branches would add from <0.1 ton per acre to 6 tons per acre of consumed fuel, depending on the species and age class.

The estimated foliage mass consumed by crown fires is presented in Table 3-6. FCCs with zero consumption are those with no standing trees (i.e., bare ground).

Table 3-6
Crown Mass Consumption by Fuel Condition Class[1,2]

FCC	Consumption (tons/acre)	FCC	Consumption (tons/acre)	FCC	Consumption (tons/acre)	FCC	Consumption (tons/acre)	FCC	Consumption (tons/acre)
1	0.00	41	8.94	81	9.04	121	0.38	161	0.27
2	0.00	42	8.94	82	9.04	122	0.38	162	0.27
3	0.00	43	8.94	83	9.04	123	0.38	163	0.00
4	8.17	44	8.94	84	9.04	124	0.38	164	4.83
5	8.17	45	8.94	85	9.04	125	0.38	165	6.17
6	8.17	46	8.94	86	9.04	126	0.38	166	0.00
7	4.83	47	8.94	87	9.04	127	0.38	167	4.83
8	4.83	48	8.94	88	9.04	128	0.38	168	6.17
9	4.83	49	8.94	89	9.04	129	0.38	169	0.00
10	5.30	50	8.94	90	9.04	130	2.48	170	4.83
11	5.30	51	8.94	91	13.23	131	2.48	171	6.17
12	5.30	52	0.00	92	13.23	132	2.48	172	0.00
13	0.98	53	0.00	93	13.23	133	2.48	173	0.00
14	0.98	54	0.00	94	13.23	134	2.48	174	0.00
15	0.98	55	17.25	95	13.23	135	2.48	175	0.00
16	0.98	56	17.25	96	13.23	136	2.48	176	0.00
17	0.98	57	17.25	97	13.23	137	2.48	177	0.00
18	0.98	58	18.01	98	13.23	138	2.48	178	18.01
19	0.98	59	18.01	99	13.23	139	2.48	179	18.01
20	0.98	60	18.01	100	13.23	140	2.48	180	18.01
21	0.98	61	33.59	101	13.23	141	2.48	181	18.01
22	0.98	62	33.59	102	13.23	142	1.24	182	18.01
23	0.98	63	33.59	103	0.00	143	1.24	183	18.01
24	0.98	64	1.70	104	0.00	144	1.24	184	4.83
25	0.98	65	1.70	105	0.00	145	1.24	185	5.30
26	0.98	66	1.70	106	6.40	146	1.24	186	18.01
27	0.98	67	1.70	107	6.40	147	1.24	187	33.59
28	6.81	68	1.70	108	6.40	148	1.24	188	6.40
29	6.81	69	1.70	109	6.17	149	1.24		
30	6.81	70	1.70	110	6.17	150	1.24		
31	6.81	71	1.70	111	6.17	151	1.24		
32	6.81	72	1.70	112	2.46	152	1.24		
33	6.81	73	1.70	113	2.46	153	1.24		
34	6.81	74	1.70	114	2.46	154	0.00		
35	6.81	75	1.70	115	0.38	155	0.00		
36	6.81	76	1.70	116	0.38	156	0.00		
37	6.81	77	1.70	117	0.38	157	0.27		
38	6.81	78	1.70	118	0.38	158	0.27		
39	6.81	79	9.04	119	0.38	159	0.27		
40	8.94	80	9.04	120	0.38	160	0.27		

[1] Consumption of foliage mass only
[2] Source: Brown (1978)

3.8 Wildfire and Prescribed Fire Emission Factors

FETM uses fire emission factors developed by Ward and Hardy (1991) for both prescribed fire and wildfire in the Pacific Northwest (Table B-5). These emission factors are average values weighted by the proportion of time in both the flaming and smoldering phases for several fuel types. Fuel types include: short-needled conifers, long-needled conifers, hardwoods, sage, chaparral, and piled slash. The emission factors are expressed in units of pounds of pollutant (in this case, PM_{10}) per ton of fuel consumed. The PM_{10} estimates are inferred values from real measurements collected for all particulate matter and for particulate matter less than 2.5 microns in diameter ($PM_{2.5}$). PM_{10} emission factors were used because most current regulations are based on PM_{10} standards. A team of fuels and emissions specialists were convened to evaluate each FCC and assign an appropriate emission factor (see Acknowledgements).

Chapter 4
Modeling Results

This chapter summarizes the modeling scenarios that were chosen to evaluate FETM, and the preliminary output from these scenarios.

4.1 Modeling Scenarios

Two modeling scenarios were chosen to evaluate the performance of the Fire Emissions Tradeoff Model within the Grande Ronde River Basin: (1) Base and (2) Enhanced Utilization and Mechanical Treatment. The Base scenario uses the original transition matrices developed by the project team in 1994 (see Section 3.4), which represents the most likely management scenario under current-day management policies within the region. The Enhanced Utilization and Mechanical Treatment scenario assumes a more aggressive fuels treatment program using primarily non-fire techniques. This scenario was chosen by the study team (see Acknowledgements) to demonstrate the opportunity for reducing the fuel loading across the Basin without attendant increases in smoke emissions from prescribed fires.

Development of the Enhanced Utilization and Mechanical Treatment scenario resulted in few modifications to the Base scenario. The most significant change was a reduction in the harvest rotation age for ponderosa pine from 303 years in the Base scenario to 150 years in the Enhanced Utilization and Mechanical Treatment scenario. The rotation ages for mixed conifer (100 years) and lodgepole pine (80 years) were already as low as possible from a management standpoint, and therefore remained unchanged in the Enhanced Utilization and Mechanical Treatment scenario. Another important difference included a 30-year entry cycle for mechanical treatment of ponderosa pine (3.3 percent per year). All other modeling inputs are as described in Chapter 3.

Both scenarios were run for 100 years of simulation (starting from the present) and 6 levels of prescribed fire treatment (i.e., no treatment, 1 percent, 2 percent, 3 percent, 4 percent, and 5 percent). A set of 30 independent runs of the model was chosen to provide an adequate sampling of the consequences of fires and management activities over the 100-year simulation time period. The results from the 30 runs were used to compute the *average* results from each scenario.

Because the rules used to define the Enhanced Utilization and Mechanical Treatment scenario did not result in significant changes in the transition matrices, there were negligible differences in the modeling results. For this reason, only the results from the Base scenario are presented.

4.2 Preliminary Results

4.2.1 Acreage Distribution

Figures C-1a through C-1s (Appendix C) illustrate the change in FCC acres over the 100-year simulation period following utilization, mechanical treatment, wildfire, natural succession, and prescribed fire at the 4 percent level of treatment. The net effect of these disturbances has been a dramatic reduction in the number of acres in some FCCs over time, and a dramatic increase in others. The FCCs showing the largest gains in total acreage over the 100-year simulation are presented in Table 4-1 (see Table 3-5 for key to FCC numbers). The FCCs showing the greatest losses in the total acreage over the 100-year simulation are presented in Table 4-2.

Table 4-1
FCCs with Large Acreage Gains Over 100-Year Simulation Period, Base Scenario

FCC	Description	Acres in Year 0	Acres in Year 100
1	Ponderosa pine, bare, low loading	1,800	11,800
10	Ponderosa pine, overmature, low loading	1,600	9,700
52	Mixed conifer, bare, low loading	2,100	11,200
61	Mixed conifer, overmature, low loading	7,500	96,300
62	Mixed conifer, overmature, medium loading	7,200	20,900
86	Mixed conifer, mature, medium loading, logged with YUM	16,700	23,600
92	Mixed conifer, overmature, low loading, logged (fuel treatment backlog)	50	5,100
98	Mixed conifer, overmature, medium loading, logged with YUM	70	6,200
112	Lodgepole pine, overmature, low loading	600	10,000
113	Lodgepole pine, overmature, medium loading	1,100	9,500
163	Grass, mature, low loading	35,000	94,100
164	Grass/ponderosa pine, mature, low loading	150	13,600
172	Shrub, immature, low loading	1,900	9,400
175	Shrub, mature, low loading	1,800	14,600
184	Ponderosa pine, mature, very low loading	19,300	39,400
185	Ponderosa pine, overmature, very low loading	1,400	39,000
186	Mixed conifer, mature, very low loading	166,400	219,900
187	Mixed conifer, overmature, very low loading	5,200	369,500
188	Lodgepole pine, immature, very low loading	4,900	43,500

Table 4-2 FCCs With Large Acreage Losses Over 100-Year Simulation Period, Base Scenario			
FCC	Description	Acres in Year 0	Acres in Year 100
5	Ponderosa pine, immature, medium loading	6,900	20
6	Ponderosa pine, immature, high loading	6,600	5
7	Ponderosa pine, mature, low loading	19,100	3,100
8	Ponderosa pine, mature, medium loading	18,100	1,500
9	Ponderosa pine, mature, high loading	17,800	1,600
15	Ponderosa pine, immature, low loading, precommercial or commercial thin with no mechanical fuels treatment	6,900	1,900
20	Ponderosa pine, immature, medium loading, commercial thin with lop-and-scatter fuels treatment	10,500	50
25	Ponderosa pine, immature, high loading, commercial thin with lop-and-scatter fuels treatment	12,400	10
29	Ponderosa pine, mature, low loading, logged	5,500	400
56	Mixed conifer, immature, medium loading	19,300	200
57	Mixed conifer, immature, high loading	18,400	40
58	Mixed conifer, mature, low loading	161,400	28,500
59	Mixed conifer, mature, medium loading	153,400	10,100
60	Mixed conifer, mature, high loading	149,800	1,100
71	Mixed conifer, immature, medium loading, commercial thin with lop-and-scatter fuels treatment	10,200	100
76	Mixed conifer, immature, high loading, commercial thin with lop-and-scatter fuels treatment	12,400	30
80	Mixed conifer, mature, low loading, logged	14,600	3,100
82	Mixed conifer, mature, low loading, logged with YUM fuels treatment	17,900	10,100
84	Mixed conifer, mature, medium loading, logged	11,400	4,100
88	Mixed conifer, mature, high loading, logged	9,400	500
90	Mixed conifer, mature, high loading, logged with YUM fuels treatment	8,500	10
110	Lodgepole pine, mature, medium loading	16,700	1,000
111	Lodgepole pine, mature, high loading	16,300	300
166	Grass, mature, medium loading	29,700	200
169	Grass, mature, high loading	29,700	200

Overall, these results show the largest net gains in the Shrub type (about 14,000 acres), followed by Grass (about 11,000 acres), then Mixed Conifer (about 11,000 acres), and then Lodgepole Pine (about 2,000 acres). The only net loss came in the Ponderosa Pine type (about 38,000 acres).

Most of the gains are in natural stand types at the extremes of the successional spectrum (i.e., bare ground, overmature). Most of the losses have been observed in the activity fuels and natural fuels at center of the successional spectrum (i.e., immature, mature).

The greatest movement of acres within individual FCCs is from the mature Mixed Conifer stands with low, medium, and high loading (FCC 58, FCC 59, FCC 60) to overmature Mixed Conifer stands with very low loading (FCC 187). The loss from FCCs 58, 59, and 60 is attributable to utilization of mature Mixed Conifer (0.83 percent per year); the gain in FCC 187 is attributable to inflow from overmature Mixed Conifer (low loading) following prescribed fire and wildfire.

4.2.2 Wildfire Acres Burned

The number of wildfire acres burned over time for each of the six levels of prescribed fire treatment (zero through 5 percent, in 1-percent increments) are presented in Figures C-2 through C-7. The figures show the annual variation in wildfire acres, the time-average wildfire acres, and a *loess* fit to the annual wildfire data. Loess is an S function used to fit a local regression model to the set of data. The loess fit provides a better indication of the trend in wildfire acres burned than the arithmetic mean, which is highly sensitive to sample size in the first few years of simulation. The loess fit will be used as the primary measure of the trend in wildfire acres over time.

According to Figures C-2 through C-7, approximately 7,000 acres are expected to be consumed by wildfire each year, at least in the first several years of simulation. This compares favorably with historical wildfire data for the Grande Ronde River Basin, as well as the surrounding region, for the period from 1970 through 1993 (Table 4-3).

With no treatment (Figure C-2), the number of wildfire acres is expected to increase slightly over the 100-year simulation period. This is attributable to an overall increase in fuel loading following natural succession.

Over time, the number of acres consumed by wildfire is expected to decrease as the level of prescribed fire treatment increases. In these preliminary model runs, approximately two rotations of prescribed fire are needed to sufficiently decrease the crown-fire potential so that the wildfire acreage drops to near zero (i.e., tens of acres, not zero). For example, at the 3 percent level of prescribed fire treatment (33-year rotation), the wildfire acreage drops to near-zero at about 70 years in the simulation. At the 5 percent level of prescribed fire treatment (20-year rotation), the wildfire acreage drops to near-zero at about 40 years in the simulation.

The decrease in the number of acres consumed by wildfire will produce corresponding decreases in wildfire emissions.

Table 4-3 Comparison of Wildfire Statistics[1] Base Scenario			
Data Sources	**Mean Annual Wildfire Acres (acres)**	**Mean Annual Wildfire Frequency (number/year)**	**Single-Event Fire Size[2] (acres)**
FETM	6,877	2.8	5,993
Grande Ronde River Basin[3]	1,184	1.8	5,556
Nine National Forests[4]	4,818	3.4	16,581

[1] Class C fires and larger.
[2] Extreme fire weather class only.
[3] Based on data from Umatilla and Wallowa-Whitman National Forests, 1984-1993 inclusive.
[4] Based on data for the Umatilla, Wallowa-Whitman, Ochoco, Deschutes, Malheur, Fremont, Wenatchee, Boise, and Payette National Forests, 1970-1992 inclusive; normalized to size of study area.

4.2.3 Fire Emissions Over Time

The quantities of wildfire, prescribed fire, and total (wildfire plus prescribed fire) emissions over time for each of the six levels of prescribed fire treatment (zero through 5 percent, in 1 percent increments) are presented in Figures C-8 through C-13. In this case, the modeled pollutant is particulate matter less than 10 microns in diameter (PM_{10}) in pounds of PM_{10} emitted. The emissions presented are *year-by-year* arithmetic averages (not running averages) of the results from 30 independent model runs over the 100-year simulation time period.

The wildfire emissions curves mirror the number of wildfire acres burned (see Figures C-2 through C-7). Over time, the total emissions from both prescribed fire and wildfire is expected to decrease as the pool of available acres in critical FCCs (i.e., ones that produce large quantities of smoke emissions) are reduced through fuel treatment–whether by utilization, mechanical treatment, wildfire, or prescribed fire.

On a per-acre basis, prescribed fire emissions are approximately one-half those of wildfire emissions (for example, compare Figures C-3 and C-9). This is attributable to reduced fuel consumption (which is a result of higher fuel moisture contents during the spring or fall burning periods) and overall lower emission factors for prescribed fire than wildfire.

4.2.4 Fire Emissions Versus Level of Treatment

The quantities of wildfire and prescribed fire emissions versus level of prescribed fire treatment are presented in Figures C-14 through C-21. These figures show the emission tradeoffs at 8 different years in the simulation: at 0, 10, 20, 30, 40, 50, 75, and 100 years. These figures permit the user to evaluate the tradeoffs between wildfire and prescribed fire emissions at different levels of prescribed fire treatment.

For the first 30 years of simulation, total emissions are expected to increase monotonically with increasing levels of prescribed fire treatment (see Figures C-14 through C-17). From 30 to 80 years, total emissions are expected to remain relatively constant with increasing levels of prescribed fire treatment (see Figures C-18 through C-20). From 80 to 100 years, an absolute minimum in the total emissions curve occurs at about the 2 percent level of prescribed fire treatment (see Figure C-21), which equates to about 24,000 acres per year.

Figure C-22 presents a surface plot of total emissions over time and level of prescribed fire treatment. This figure illustrates the relative "flattening" of the combined emissions curve beginning at year 50 and continuing out to year 100.

Although the model is not currently capable of evaluating varying levels of prescribed fire treatment within the same 100-year simulation period (the model assumes a fixed level of treatment for the entire period), it might be possible to minimize the impact from a more active prescribed fire treatment program by gradually increasing the level of prescribed fire treatment over time within the Basin. The level of treatment might be increased from about 1 percent of the available area (12,000 acres) in the starting year to 2 percent of the available area (24,000 acres) by the 50th year, and then to 5 percent of the available area (60,000 acres) by the 70th year <u>without</u> dramatically increasing the total smoke emissions within the Basin. According to the preliminary modeling results, emissions might be expected to increase from about 6.6 million pounds of PM_{10} (particulate matter less than 10 micrometers in diameter) in the starting year to about 7.0 million pounds of PM_{10} by year 50, and then decrease to 6.2 million pounds of PM_{10} by year 70. Overall, a net decrease in total emissions of about 6 percent (400,000 pounds or 200 tons per year) would be expected over starting levels.

Chapter 5
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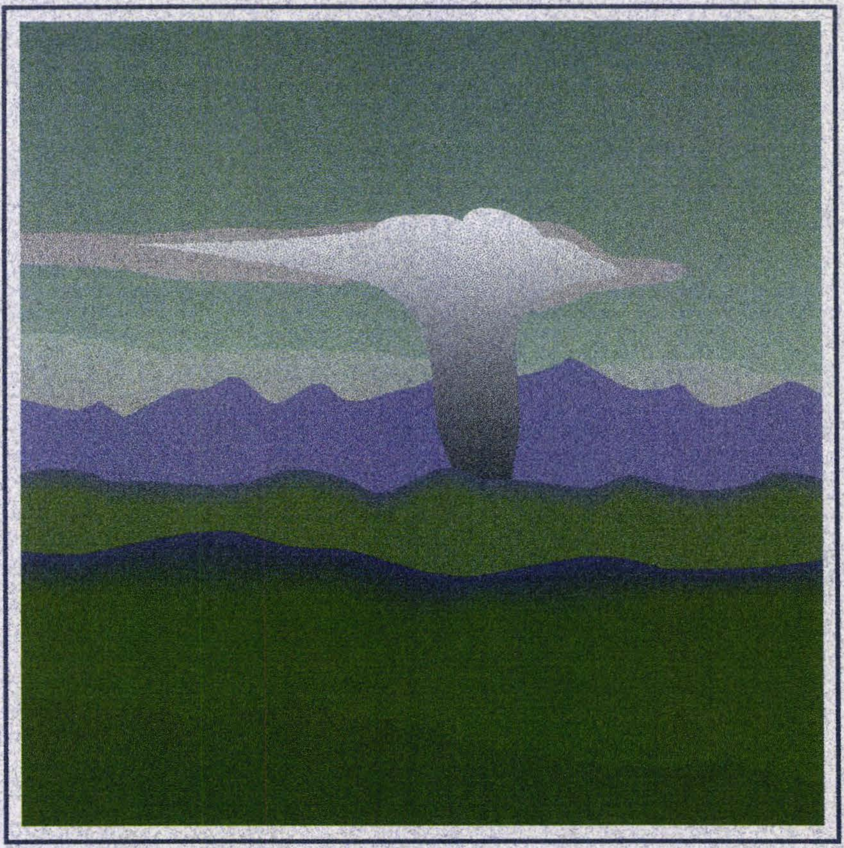
Appendix A

Assessment of Surface-Fuel Fire Behavior within the Grande Ronde River Basin, Oregon



Appendix A

Assessment of Surface-Fuel Fire Behavior within the Grande Ronde River Basin, Oregon

Introduction

This appendix summarizes the methods used to assess fire behavior for the fuel condition classes (FCCs) modeled in the Fire Emissions Tradeoff Model (FETM). As described in Chapter 3 of this report, FETM uses 188 different FCCs to characterize the current and expected future fuel conditions (i.e., type, loading, structure) within the Grande Ronde River Basin. This does not imply that 188 different fuel profiles (or 188 unique fire behaviors) can be expected within the study area. On the contrary, it was the opinion of the team that perhaps 20 or 30 different fuel profiles (and fire behaviors) could be ascertained, provided some additional analysis was performed to expand the existing NFDRS fuel models to approximate more closely the conditions found within the Grande Ronde River Basin. The necessity to track 188 different FCCs was driven in part by a requirement in the program to isolate the acreage in a vegetation type (e.g., grass) following one successional path (for example, grass that remains in a stable grass community) from the acreage in the same type diverging along another path of succession (for example, grass succeeding to lodgepole pine).

The fire behavior assessment was conducted by a team of fuel and fire behavior specialists, including John Deeming, Fire Behavior Consultant, Wildland Fire Technologies, Bend, Oregon; Don Carlton, Fire Planning Specialist and Fire Behavior Analyst, USDA Forest Service Region 6, Portland, Oregon; John Nesbitt, Fuels Specialist, USDA Forest Service Region 6, Portland, Oregon; and Roger Ottmar, Research Forester, USDA Forest Service, Seattle Forestry Research Laboratory, Seattle, Washington. Team members were selected on the basis of their experience with estimating fuel loading and modeling fire behavior and their knowledge of fuel conditions within the study area. Assisting in the development and review of these tasks were analysts Marc Wiitala, USDA Forest Service, Region 6, and Mark Schaaf, CH2M HILL, Portland, Oregon.

This appendix summarizes the analysis performed to assess the expected fire behavior (specifically, the rate of fire spread by FCC) within the study area. Two major topics are summarized. The first topic discussed is the process used to develop and expand the existing National Fire Danger Rating System (NFDRS) fuel models and assign them to each of the 188 FCCs identified within the study area. The second topic is the process used to run the pcFIRDAT fire behavior model using site-specific weather and fuels data. This includes a discussion of the process used to determine the percentile spread components by fire weather class.

Process to Develop and Expand Existing NFDRS Fuel Models

Initial Assignment of NFDRS Fuel Models

Initially, Roger Ottmar (USDA Forest Service, Pacific Northwest Research Station, Seattle) paired each of the 188 FCCs contained in the FETM model with one of the 20 1978 National Fire Danger Rating System (NFDRS) fuel models ("root model"). The root model was assigned based on a comparison of fuel loadings by size class (with emphasis on the 0- through 3-inch-diameter class) for all dead and down material, and by the overall condition of the fuel presented in published photographic series. Two photographic series were used: General Technical Report PNW-52 (Maxwell and Ward, 1976), and General Technical Report PNW-105 (Maxwell and Ward, 1980). The actual fuel characteristics for each FCC were estimated by Roger Ottmar using stand examination data from the Umatilla National Forest and Wallowa-Whitman National Forest, as well as data from the published photographic series.

Information on the NFDRS fuel characteristics needed for the initial comparison was taken from the FUELBD88.DAT file contained in the pcFIRDAT model. The FUELBD88.DAT file contains information on fuel particle and fuel bed characteristics for each of the 20 NFDRS fuel models (A-L and N-U).

Eleven NFDRS models were chosen to represent conditions in the Grande Ronde River Basin, including: A (annual western grasses), C (pine-grass savanna), F (intermediate brush), G (short needle, heavy dead), H (short needle, normal dead), J (intermediate slash), K (light slash), L (perennial western grasses), S (tundra; a surrogate for mountain meadows), T (sagebrush-grass), and U (western pines).

Expansion of Initial NFDRS Fuel Models

An expanded NFDRS fuel model set was then developed using variants of the above models. Three variants of A, C, F, G, H, L, S, T, and U were developed, and six variants of J and K were developed. For the first group, the variants included low, medium, and high loading categories. The medium loading category was constructed using data (e.g., loading by size class, fuel bed depth) from the root fuel model. The low loading category was constructed by *decreasing* the root fuel model's loading and fuel bed depth in a manner consistent with conserving the relative packing ratio (designated β/β_{opt}). The high loading category was constructed by *increasing* the root fuel-model's loading and bed depth by one-third. Changing the loading and bed depth assured that the high and low variants had the same relative packing ratio and characteristic surface area-to-volume ratio as the root model. Following the advice of Don Carlton, the loading and fuel bed depths from the USDA Forest Service's Fuels Appraisal Process (FAP) models (USFS, 1990) were used to derive the J and K variants.

No changes were made to the fuel class surface area-to-volume ratios, extinction moisture contents, or heat values. Custom 20-foot wind reduction factors, however, were assigned to

each model; the standard wind reduction factors contained in the default FUELBD88.DAT file were not used.

Fuel models for "piled" slash were not developed because of the discontinuous and non-uniform nature of slash piles. These characteristics are inconsistent with the assumption of a continuous, uniform fuel bed used in the fire danger rating system models. For FCCs with piled slash, a nominal spread component of 1 foot/minute was assumed in the fire growth matrix.

A shading category–shaded or unshaded–was also assigned corresponding to the degree of shading apparent in the designated photographic series. Because pcFIRDAT does not explicitly account for shading effects (manifested as an increase in fuel moisture over the unshaded environment), John Deeming used the guidance in Rothermel (1983) to approximate the difference in fire spread between shaded and unshaded fuel beds. The SCs in shaded fuel beds were assumed to be approximately 75 percent of the unshaded SCs in the 90th to 100th percentile range, and 85 percent of the unshaded SCs in the 40th to 60th percentile range (John Deeming, Wildland Fire Technologies, personal communication). These factors were used to reduce the output SCs as appropriate below.

Assignment of Expanded NFDRS Fuel Models

An expanded NFDRS fuel model was assigned to each of the 188 FCCs based on the fuelbed depth and loading in the 0- through 3-inch dead-and-down material, as well as by the overall appearance of fuel conditions in the published photographic series. A total of 49 different fuel models was identified, each assigned to one or more of the 188 FCCs. A complete listing of the FCCs and corresponding extended NFDRS fuel models and their respective fuel loading characteristics is presented in Table A-1.

Some liberty was taken in using the 0- to 3-inch loading to assign fuel models to the "crushed" FCCs. Crushing will undoubtedly alter the loading in the 0 to 3-inch category because some of the material is ground into the soil by the action of the heavy equipment. For this reason, the loading category for all "crushed" FCCs was reduced by one category. For example, if the pre-treatment loading in the 0 to 3-inch category for an FCC was rated as high, the post-treatment loading for the same FCC would be rated as medium.

Process Used to Run the pcFIRDAT Fire Behavior Model

The approach summarized above was used to develop modified versions of the FUELBD88.DAT file, which contains fuel particle and fuel bed characteristics for each of the 20 default NFDRS fuel models (A-L and N-U). The modified FUELBD88.DAT files were then processed through pcFIRDAT to obtain cumulative frequency distributions of the spread component, from which estimates of the fire spread rate were determined for each of the three fire weather classes in this investigation.

Table A-1

Fuel Loading and Stand Characteristics for Fuel Condition Classes

FCC	Deeming's Extended NFDRS Fuel Models	Carlton's IAA Fuel Models	Vegetation Type	Age Class	Loading Class	Activity Class	Fuel Loading												Duff Depth (inches)	Fuel Depth (feet)	Ladder Fuel Height (feet)
							Shrub (t/ac)	Herb (t/ac)	Total (t/ac)	1-hr (t/ac)	10-hr (t/ac)	100-hr (t/ac)	1000 (t/ac)	10000 (t/ac)	10000+ (t/ac)	Total (t/ac)	Duff (t/ac)	Total (t/ac)			
1	HL / 0.4 / Unsh.	HL3	PP	Bare	Low		0.4	0.3	0.7	0.5	0.8	1.7	1.9	3.0	0.0	7.9	2.3	10.9	0.3	0.25	-
2	HM / 0.3 / Unsh.	HM2	PP	Bare	Medium		0.5	0.5	1.0	0.5	1.9	5.1	3.4	4.1	0.0	15.0	2.3	18.3	0.3	0.40	-
3	HL / 0.4 / Unsh.	HL3	PP	Bare	High		0.4	0.5	0.9	0.5	0.4	2.3	2.7	4.2	8.4	18.5	2.3	21.7	0.3	0.40	-
4	UM / 0.2 / Sh.	UM1	PP	Immature	Low		0.5	0.5	1.0	0.1	1.5	2.2	1.1	1.8	3.3	10.0	6.0	17.0	0.8	0.50	12
5	CM / 0.2 / Sh.	CM1	PP	Immature	Medium		0.5	0.8	1.3	0.1	1.5	4.8	5.5	2.3	3.3	17.5	6.0	24.8	0.8	1.00	12
6	CH / 0.2 / Sh.	CH1	PP	Immature	High		0.7	1.1	1.8	0.1	3.9	4.5	9.5	3.0	3.3	24.3	6.0	32.1	0.8	1.00	12
7	UL / 0.2 / Sh.	UL1	PP	Mature	Low		0.4	0.8	1.2	0.1	0.6	1.6	0.4	1.0	5.6	9.3	9.8	20.3	1.3	0.25	23
8	UM / 0.2 / Sh.	UM1	PP	Mature	Medium		0.0	0.0	0.0	0.1	1.6	4.2	2.1	2.9	4.7	15.6	9.8	25.4	1.3	0.50	23
9	HM / 0.2 / Sh.	HM1	PP	Mature	High		0.4	0.3	0.7	0.1	1.1	2.5	10.3	6.0	3.6	23.6	9.8	34.1	1.3	0.50	23
10	TM / 0.2 / Sh.	TM1	PP	Overmature	Low		2.5	0.5	3.0	0.2	1.2	2.3	2.3	2.4	2.0	10.4	12.8	26.2	1.7	0.50	27
11	HM / 0.2 / Sh.	HM1	PP	Overmature	Medium		0.5	0.5	1.0	0.0	1.5	4.9	10.1	6.2	4.0	26.7	12.8	40.6	1.7	1.00	27
12	UL / 0.2 / Sh.	UL1	PP	Overmature	High		0.4	0.3	0.7	0.0	0.3	1.5	6.7	22.8	9.0	40.3	12.8	53.9	1.7	1.00	27
13	Piled	P	PP	Immature	Low	PCT/Pile	0.0	0.0	0.0	0.5	3.4	2.3	1.9	0.0	0.0	8.1	8.3	16.4	1.1	0.50	12
14	KLC / 0.2 / Sh.	KL1	PP	Immature	Low	PCT/L&S or Crush	0.0	0.0	0.0	0.5	3.4	2.3	1.9	0.0	0.0	8.1	8.3	16.4	1.1	0.30	12
15	KL / 0.2 / Sh.	KL2	PP	Immature	Low	PCT or CT/NMT	0.0	0.0	0.0	0.5	3.4	2.3	1.9	0.0	0.0	8.1	8.3	16.4	1.1	0.50	12
16	Piled	P	PP	Immature	Low	CT/Pile	0.0	0.0	0.0	0.5	2.7	5.5	1.0	0.0	0.0	9.7	8.3	18.0	1.1	0.50	12
17	KLC / 0.2 / Sh.	KL1	PP	Immature	Low	CT/L&S or Crush	0.0	0.0	0.0	0.5	2.7	5.5	1.0	0.0	0.0	9.7	8.3	18.0	1.1	0.30	12
18	Piled	P	PP	Immature	Medium	PCT/Pile	0.0	0.0	0.0	0.5	5.2	7.0	3.9	0.0	0.0	16.6	8.3	24.9	1.1	1.20	12
19	JLC / 0.2 / Sh.	JL1	PP	Immature	Medium	PCT/L&S or Crush	0.0	0.0	0.0	0.5	5.2	7.0	3.9	0.0	0.0	16.6	8.3	24.9	1.1	0.75	12
20	JL / 0.2 / Sh.	JL3	PP	Immature	Medium	CT/L&S or Crush	0.0	0.0	0.0	0.5	5.2	7.0	3.9	0.0	0.0	16.6	8.3	24.9	1.1	1.20	12
21	Piled	P	PP	Immature	Medium	CT/Pile	0.0	0.0	0.0	0.5	5.2	7.0	3.9	0.0	0.0	16.6	8.3	24.9	1.1	1.20	12
22	JLC / 0.2 / Sh.	JL1	PP	Immature	Medium	CT/L&S or Crush	0.0	0.0	0.0	0.5	5.2	7.0	3.9	0.0	0.0	16.6	8.3	24.9	1.1	0.75	12
23	Piled	P	PP	Immature	High	PCT/Pile	0.0	0.0	0.0	0.5	5.5	6.7	12.8	0.0	3.5	29.0	8.3	37.3	1.1	1.80	12
24	JLC / 0.2 / Sh.	JL1	PP	Immature	High	PCT/L&S or Crush	0.0	0.0	0.0	0.5	5.5	6.7	12.8	0.0	3.5	29.0	8.3	37.3	1.1	1.00	12
25	JL / 0.2 / Sh.	JL3	PP	Immature	High	CT/L&S or Crush	0.0	0.0	0.0	0.5	5.5	6.7	12.8	0.0	3.5	29.0	8.3	37.3	1.1	1.80	12
26	Piled	P	PP	Immature	High	CT/Pile	0.0	0.0	0.0	0.5	5.5	6.7	3.9	0.0	3.5	20.1	8.3	28.4	1.1	1.00	12
27	JLC / 0.2 / Sh.	JL1	PP	Immature	High	CT/L&S or Crush	0.0	0.0	0.0	0.5	5.5	6.7	3.9	0.0	3.5	20.1	8.3	28.4	1.1	0.75	12
28	KM / 0.3 / Unsh.	KM5	PP	Mature	Low	Logged	0.0	0.0	0.0	0.5	2.7	5.0	5.7	0.0	0.0	13.9	6.0	19.9	0.8	0.30	33
29	KM / 0.3 / Unsh.	KM5	PP	Mature	Low	Logged	0.0	0.0	0.0	0.5	2.7	5.0	5.7	0.0	0.0	13.9	6.0	19.9	0.8	0.30	33
30	KLC / 0.3 / Unsh.	KL3	PP	Mature	Low	Logged/Crush	0.0	0.0	0.0	0.5	2.7	5.0	5.7	0.0	0.0	13.9	6.0	19.9	0.8	0.20	33
31	KM / 0.2 / Sh.	KM4	PP	Mature	Low	Logged/YUM	0.0	0.0	0.0	0.5	2.2	3.4	2.9	0.0	0.0	9.0	6.0	15.0	0.8	0.30	33
32	KM / 0.3 / Unsh.	KM5	PP	Mature	Medium	Logged	0.0	0.0	0.0	0.5	2.3	4.8	4.3	6.2	0.0	18.1	6.0	24.1	0.8	0.50	33
33	KM / 0.3 / Unsh.	KM5	PP	Mature	Medium	Logged	0.0	0.0	0.0	0.5	2.3	4.8	4.3	6.2	0.0	18.1	6.0	24.1	0.8	0.50	33
34	KLC / 0.3 / Unsh.	KL3	PP	Mature	Medium	Logged/Crush	0.0	0.0	0.0	0.5	2.3	4.8	4.3	6.2	0.0	18.1	6.0	24.1	0.8	0.40	33
35	KM / 0.3 / Unsh.	KM5	PP	Mature	Medium	Logged/YUM	0.0	0.0	0.0	0.5	2.7	5.0	3.7	1.0	1.0	13.9	6.0	19.9	0.8	0.50	33
36	JL / 0.3 / Unsh.	JL4	PP	Mature	High	Logged	0.0	0.0	0.0	0.5	3.8	7.4	7.1	4.6	6.6	30.0	6.0	36.0	0.8	0.50	33
37	JL / 0.3 / Unsh.	JL4	PP	Mature	High	Logged	0.0	0.0	0.0	0.5	3.8	7.4	7.1	4.6	6.6	30.0	6.0	36.0	0.8	0.50	33
38	JLC / 0.3 / Unsh.	JL2	PP	Mature	High	Logged/Crush	0.0	0.0	0.0	0.5	3.8	7.4	7.1	4.6	6.6	30.0	6.0	36.0	0.8	0.40	33
39	KM / 0.3 / Unsh.	KM5	PP	Mature	High	Logged/YUM	0.0	0.0	0.0	0.5	2.3	4.8	4.3	8.2	2.5	22.6	6.0	28.6	0.8	0.50	33
40	KM / 0.3 / Unsh.	KM5	PP	Overmature	Low	Logged	0.0	0.0	0.0	0.5	2.7	5.0	5.7	2.0	2.0	17.9	6.0	23.9	0.8	0.30	39
41	KM / 0.3 / Unsh.	KM5	PP	Overmature	Low	Logged	0.0	0.0	0.0	0.5	2.7	5.0	5.7	2.0	2.0	17.9	6.0	23.9	0.8	0.30	39
42	KLC / 0.3 / Unsh.	KL3	PP	Overmature	Low	Logged/Crush	0.0	0.0	0.0	0.5	2.7	5.0	5.7	2.0	2.0	17.9	6.0	23.9	0.8	0.20	39
43	KM / 0.3 / Unsh.	KM5	PP	Overmature	Low	Logged/YUM	0.0	0.0	0.0	0.5	2.7	5.0	5.7	0.0	0.0	13.9	6.0	19.9	0.8	0.30	39
44	KM / 0.2 / Sh.	KM4	PP	Overmature	Medium	Logged	0.0	0.0	0.0	0.5	2.4	5.1	10.2	8.6	3.0	29.8	6.0	35.8	0.8	0.50	39
45	KM / 0.2 / Sh.	KM4	PP	Overmature	Medium	Logged	0.0	0.0	0.0	0.5	2.4	5.1	10.2	8.6	3.0	29.8	6.0	35.8	0.8	0.50	39
46	KLC / 0.2 / Sh.	KL1	PP	Overmature	Medium	Logged/Crush	0.0	0.0	0.0	0.5	2.4	5.1	10.2	8.6	3.0	29.8	6.0	35.8	0.8	0.40	39
47	KM / 0.2 / Unsh.	KM4	PP	Overmature	Medium	Logged/YUM	0.0	0.0	0.0	0.5	2.3	4.8	4.3	8.2	2.5	22.6	6.0	28.6	0.8	0.50	39

Table A-1

Fuel Loading and Stand Characteristics for Fuel Condition Classes

FCC	Deeming's Extended NFDRS Fuel Models	Carlton's IAA Fuel Models	Vegetation Type	Age Class	Loading Class	Activity Class	Fuel Loading Shrub (t/ac)	Herb (t/ac)	Total (t/ac)	1-hr (t/ac)	10-hr (t/ac)	100-hr (t/ac)	1000 (t/ac)	10000 (t/ac)	10000+ (t/ac)	Total (t/ac)	Duff (t/ac)	Total (t/ac)	Duff Depth (inches)	Fuel Depth (feet)	Ladder Fuel Height (feet)
48	KM / 0.5 / Unsh.	KM6	PP	Overmature	High	Logged	0.0	0.0	0.0	0.5	2.4	5.1	14.0	11.0	5.0	38.0	6.0	44.0	0.8	1.00	39
49	KM / 0.5 / Unsh.	KM6	PP	Overmature	High	Logged	0.0	0.0	0.0	0.5	2.4	5.1	14.0	11.0	5.0	38.0	6.0	44.0	0.8	1.00	39
50	KLC / 0.5 / Unsh.	KL4	PP	Overmature	High	Logged/Crush	0.0	0.0	0.0	0.5	2.4	5.1	14.0	11.0	5.0	38.0	6.0	44.0	0.8	0.70	39
51	KH / 0.3 / Unsh.	KH4	PP	Overmature	High	Logged/YUM	0.0	0.0	0.0	0.5	3.9	4.8	10.0	5.5	6.9	31.6	6.0	37.6	0.8	1.00	39
52	HM / 0.2 / Sh.	HM1	MC	Bare	Low		0.5	0.5	1.0	0.6	2.3	1.9	2.0	0.0	0.0	6.8	2.3	10.1	0.3	0.30	-
53	HM / 0.2 / Sh.	HM1	MC	Bare	Medium		0.5	0.5	1.0	0.5	1.3	3.0	4.5	1.5	0.0	10.8	2.3	14.1	0.3	0.70	-
54	HL / 0.2 / Sh.	HL1	MC	Bare	High		0.4	0.3	0.7	0.4	0.6	1.1	8.8	7.2	0.0	18.1	2.3	21.1	0.3	0.40	-
55	HM / 0.2 / Sh.	HM1	MC	Immature	Low		0.5	0.5	1.0	0.6	2.3	1.9	2.0	0.0	0.0	6.8	9.1	16.9	1.2	0.30	14
56	HM / 0.2 / Sh.	HM1	MC	Immature	Medium		0.5	0.5	1.0	0.5	1.3	3.0	4.5	1.5	0.0	10.8	9.1	20.9	1.2	0.70	14
57	HL / 0.2 / Sh.	HL1	MC	Immature	High		0.4	0.3	0.7	0.4	0.6	1.1	8.8	7.2	0.0	18.1	9.1	27.9	1.2	0.40	14
58	HL / 0.2 / Sh.	HL1	MC	Mature	Low		0.4	0.3	0.7	0.7	1.1	1.5	3.1	4.7	0.0	11.1	15.9	27.7	2.1	0.20	20
59	HH / 0.2 / Sh.	HH1	MC	Mature	Medium		0.7	0.7	1.4	0.5	1.8	3.5	12.3	2.3	0.0	20.4	15.9	37.7	2.1	0.20	20
60	HM / 0.2 / Sh.	HM1	MC	Mature	High .		0.5	0.5	1.0	0.7	1.6	1.9	13.9	13.7	0.0	31.8	15.9	48.7	2.1	0.30	20
61	HL / 0.2 / Sh.	HL1	MC	Overmature	Low		0.4	0.3	0.7	0.5	1.2	1.2	2.5	5.2	2.0	12.6	20.4	33.7	2.7	0.30	40
62	CM / 0.2 / Sh.	CM1	MC	Overmature	Medium		0.5	0.8	1.3	0.5	2.6	4.3	7.0	10.5	3.0	27.9	20.4	49.6	2.7	0.30	40
63	GM / 0.2 / Sh.	GM1	MC	Overmature	High		0.5	0.5	1.0	1.2	3.0	4.1	14.9	16.5	5.0	44.7	20.4	66.1	2.7	0.80	40
64	Piled	P	MC	Immature	Low	PCT/Pile	0.0	0.0	0.0	0.5	2.7	5.5	2.3	0.0	0.0	11.0	8.3	19.3	1.1	0.70	14
65	KLC / 0.2 / Sh.	KL1	MC	Immature	Low	PCT/L&S or Crush	0.0	0.0	0.0	0.5	2.7	5.5	2.3	0.0	0.0	11.0	8.3	19.3	1.1	0.50	14
66	KM / 0.2 / Sh.	KM4	MC	Immature	Low	CT/L&S or Crush	0.0	0.0	0.0	0.5	2.7	5.5	2.3	0.0	0.0	11.0	8.3	19.3	1.1	0.70	14
67	Piled	P	MC	Immature	Low	CT/Pile	0.0	0.0	0.0	0.5	2.7	5.5	2.3	0.0	0.0	11.0	8.3	19.3	1.1	0.70	14
68	KLC / 0.2 / Sh.	KL1	MC	Immature	Low	CT/L&S or Crush	0.0	0.0	0.0	0.5	2.7	5.5	2.3	0.0	0.0	11.0	8.3	19.3	1.1	0.50	14
69	Piled	P	MC	Immature	Medium	PCT/Pile	0.0	0.0	0.0	0.5	5.2	13.0	3.9	0.0	0.0	22.6	8.3	30.9	1.1	0.80	14
70	JLC / 0.2 / Sh.	JL1	MC	Immature	Medium	PCT/L&S or Crush	0.0	0.0	0.0	0.5	5.2	13.0	3.9	0.0	0.0	22.6	8.3	30.9	1.1	0.50	14
71	JM / 0.2 / Sh.	JM2	MC	Immature	Medium	CT/L&S or Crush	0.0	0.0	0.0	0.5	5.2	13.0	3.9	0.0	0.0	22.6	8.3	30.9	1.1	0.80	14
72	Piled	P	MC	Immature	Medium	CT/Pile	0.0	0.0	0.0	0.5	2.7	5.0	5.7	0.0	0.0	13.9	8.3	22.2	1.1	0.50	14
73	KLC / 0.3 / Unsh.	KL3	MC	Immature	Medium	CT/L&S or Crush	0.0	0.0	0.0	0.5	2.7	5.0	5.7	0.0	0.0	13.9	8.3	22.2	1.1	0.30	14
74	Piled	P	MC	Immature	High	PCT/Pile	0.0	0.0	0.0	0.5	5.5	13.7	8.8	0.0	3.5	32.0	8.3	40.3	1.1	1.80	14
75	JLC / 0.2 / Sh.	JL1	MC	Immature	High	PCT/L&S or Crush	0.0	0.0	0.0	0.5	5.5	13.7	8.8	0.0	3.5	32.0	8.3	40.3	1.1	1.00	14
76	JM / 0.2 / Sh.	JM2	MC	Immature	High	CT/L&S or Crush	0.0	0.0	0.0	0.5	5.5	13.7	8.8	0.0	3.5	32.0	8.3	40.3	1.1	1.80	14
77	Piled	P	MC	Immature	High	CT/Pile	0.0	0.0	0.0	0.5	5.2	13.0	3.9	0.0	0.0	22.6	8.3	30.9	1.1	0.80	14
78	JLC / 0.2 / Sh.	JL1	MC	Immature	High	CT/L&S or Crush	0.0	0.0	0.0	0.5	5.2	13.0	3.9	0.0	0.0	22.6	8.3	30.9	1.1	0.60	14
79	JM / 0.3 / Unsh.	JM3	MC	Mature	Low	Logged	0.0	0.0	0.0	0.5	2.7	5.0	5.7	3.0	1.0	17.9	15.1	33.0	2.0	0.30	36
80	JM / 0.3 / Unsh.	JM3	MC	Mature	Low	Logged	0.0	0.0	0.0	0.5	2.7	5.0	5.7	3.0	1.0	17.9	15.1	33.0	2.0	0.30	36
81	KLC / 0.3 / Unsh.	KL3	MC	Mature	Low	Logged/Crush	0.0	0.0	0.0	0.5	2.7	5.0	5.7	3.0	1.0	17.9	15.1	33.0	2.0	0.20	36
82	KM / 0.3 / Unsh.	KM5	MC	Mature	Low	Logged/YUM	0.0	0.0	0.0	0.5	2.7	5.0	2.0	0.0	0.0	10.2	15.1	25.3	2.0	0.30	36
83	KM / 0.2 / Sh.	KM4	MC	Mature	Medium	Logged	0.0	0.0	0.0	0.5	3.2	4.8	12.3	5.4	1.0	27.2	15.1	42.3	2.0	0.60	36
84	KM / 0.2 / Sh.	KM4	MC	Mature	Medium	Logged	0.0	0.0	0.0	0.5	3.2	4.8	12.3	5.4	1.0	27.2	15.1	42.3	2.0	0.60	36
85	KLC / 0.2 / Sh.	KL1	MC	Mature	Medium	Logged/Crush	0.0	0.0	0.0	0.5	3.2	4.8	12.3	5.4	1.0	27.2	15.1	42.3	2.0	0.40	36
86	KM / 0.3 / Unsh.	KM5	MC	Mature	MED	Logged/YUM	0.0	0.0	0.0	0.5	2.3	4.8	3.3	3.2	2.5	16.6	15.1	31.7	2.0	1.00	36
87	KH / 0.3 / Unsh.	KH4	MC	Mature	High	Logged	0.0	0.0	0.0	0.5	2.1	6.3	10.3	10.8	11.6	41.6	15.1	56.7	2.0	1.00	36
88	KH / 0.3 / Unsh.	KH4	MC	Mature	High	Logged	0.0	0.0	0.0	0.5	2.1	6.3	10.3	10.8	11.6	41.6	15.1	56.7	2.0	1.00	36
89	KMC / 0.3 / Unsh.	KM2	MC	Mature	High	Logged/Crush	0.0	0.0	0.0	0.5	2.1	6.3	10.3	10.8	11.6	41.6	15.1	56.7	2.0	0.70	36
90	KH / 0.3 / Unsh.	KH4	MC	Mature	High	Logged/YUM	0.0	0.0	0.0	0.5	2.1	6.3	4.3	5.8	7.6	26.6	15.1	41.7	2.0	0.60	36
91	KM / 0.3 / Unsh.	KM5	MC	Overmature	Low	Logged	0.0	0.0	0.0	0.5	2.3	4.8	4.3	8.2	2.5	22.6	15.1	37.7	2.0	0.30	58
92	KM / 0.3 / Unsh.	KM5	MC	Overmature	Low	Logged	0.0	0.0	0.0	0.5	2.3	4.8	4.3	8.2	2.5	22.6	15.1	37.7	2.0	0.30	58
93	KM / 0.3 / Unsh.	KM5	MC	Overmature	Low	Logged/Crush	0.0	0.0	0.0	0.5	2.3	4.8	4.3	8.2	2.5	22.6	15.1	37.7	2.0	0.20	58
94	KLC / 0.3 / Unsh.	KL3	MC	Overmature	Low	Logged/YUM	0.0	0.0	0.0	0.5	2.3	4.8	2.3	4.2	1.5	15.6	15.1	30.7	2.0	0.30	58

Table A-1

Fuel Loading and Stand Characteristics for Fuel Condition Classes

FCC	Deeming's Extended NFDRS Fuel Models	Carlton's IAA Fuel Models	Vegetation Type	Age Class	Loading Class	Activity Class	Fuel Loading Shrub (t/ac)	Herb (t/ac)	Total (t/ac)	1-hr (t/ac)	10-hr (t/ac)	100-hr (t/ac)	1000 (t/ac)	10000 (t/ac)	10000+ (t/ac)	Total (t/ac)	Duff (t/ac)	Total (t/ac)	Duff Depth (inches)	Fuel Depth (feet)	Ladder Fuel Height (feet)
95	KH / 0.3 / Unsh.	KH4	MC	Overmature	Medium	Logged	0.0	0.0	0.0	0.5	3.9	4.8	10.0	5.5	6.9	31.6	15.1	46.7	2.0	0.70	58
96	KH / 0.3 / Unsh.	KH4	MC	Overmature	Medium	Logged	0.0	0.0	0.0	0.5	3.9	4.8	10.0	5.5	6.9	31.6	15.1	46.7	2.0	0.70	58
97	KH / 0.3 / Unsh.	KH4	MC	Overmature	Medium	Logged/Crush	0.0	0.0	0.0	0.5	3.9	4.8	10.0	5.5	6.9	31.6	15.1	46.7	2.0	0.50	58
98	KMC / 0.3 / Unsh.	KM2	MC	Overmature	Medium	Logged/YUM	0.0	0.0	0.0	0.5	3.9	4.8	5.0	3.5	4.9	22.6	15.1	37.7	2.0	0.50	58
99	KH / 0.3 / Unsh.	KH4	MC	Overmature	High	Logged	0.0	0.0	0.0	0.5	2.1	6.3	10.3	10.8	11.6	41.6	15.1	56.7	2.0	1.00	58
100	KH / 0.3 / Unsh.	KH4	MC	Overmature	High	Logged	0.0	0.0	0.0	0.5	2.1	6.3	10.3	10.8	11.6	41.6	15.1	56.7	2.0	1.00	58
101	KH / 0.3 / Unsh.	KH4	MC	Overmature	High	Logged/Crush	0.0	0.0	0.0	0.5	2.1	6.3	10.3	10.8	11.6	41.6	15.1	56.7	2.0	0.70	58
102	KMC / 0.3 / Unsh.	KM2	MC	Overmature	High	Logged/YUM	0.0	0.0	0.0	0.5	2.1	6.3	5.3	5.8	10.0	30.0	15.1	45.1	2.0	0.70	58
103	HL / 0.3 / Unsh.	HL2	LP	Bare	Low		0.4	0.3	0.7	0.5	0.8	1.7	0.9	0.0	0.0	3.9	2.3	6.9	0.3	0.10	-
104	HL / 0.3 / Unsh.	HL2	LP	Bare	Medium		0.4	0.3	0.7	0.5	1.9	3.1	3.4	2.1	0.0	11.0	2.3	14.0	0.3	0.20	-
105	HH / 0.3 / Unsh.	HH2	LP	Bare	High		0.7	0.7	1.4	0.5	1.9	5.1	3.4	4.1	0.0	15.0	2.3	18.7	0.3	0.20	-
106	HM / 0.2 / Sh.	HM1	LP	Immature	Low		0.5	0.5	1.0	0.3	0.7	4.0	0.8	0.0	0.0	5.8	3.8	10.6	0.5	0.20	30
107	GM / 0.2 / Sh.	GM1	LP	Immature	Medium		0.5	0.5	1.0	0.4	1.2	7.4	2.1	0.0	0.0	11.1	3.8	15.9	0.5	0.40	30
108	GH / 0.2 / Sh.	GH1	LP	Immature	High		0.7	0.7	1.4	0.6	2.1	10.4	4.7	0.0	0.0	17.8	3.8	23.0	0.5	0.80	30
109	HM / 0.2 / Sh.	HM1	LP	Mature	Low		0.5	0.5	1.0	0.3	0.7	4.0	0.8	0.0	0.0	5.8	4.5	11.3	0.6	0.20	46
110	GM / 0.2 / Sh.	GM1	LP	Mature	Medium		0.5	0.5	1.0	0.7	2.3	5.9	5.1	2.0	0.0	16.0	4.5	21.5	0.6	0.30	46
111	GM / 0.2 / Sh.	GM1	LP	Mature	High		0.0	0.0	0.0	0.5	1.9	7.0	9.6	16.1	0.0	35.1	4.5	39.6	0.6	0.30	46
112	HL / 0.2 / Sh.	HL1	LP	Overmature	Low		0.4	0.3	0.7	0.2	0.9	1.7	1.3	3.0	0.0	7.1	6.0	13.8	0.8	0.10	36
113	HM / 0.2 / Sh.	HM1	LP	Overmature	Medium		0.5	0.5	1.0	0.2	1.1	3.4	14.8	3.5	0.0	23.0	6.0	30.0	0.8	0.30	36
114	GM / 0.2 / Sh.	GM1	LP	Overmature	High		0.5	0.5	1.0	0.5	1.9	7.0	14.6	16.1	0.0	40.1	6.0	47.1	0.8	0.50	36
115	Piled	P	LP	Immature	Low	PCT/Pile	0.0	0.0	0.0	0.5	2.4	2.3	1.9	0.0	0.0	7.1	9.8	16.9	1.3	0.40	30
116	KLC / 0.2 / Sh.	KL1	LP	Immature	Low	PCT/L&S or Crush	0.0	0.0	0.0	0.5	2.4	2.3	1.9	0.0	0.0	7.1	9.8	16.9	1.3	0.30	30
117	KL / 0.2 / Sh.	KL2	LP	Immature	Low	CT/L&S or Crush	0.0	0.0	0.0	0.5	2.4	2.3	1.9	0.0	0.0	7.1	9.8	16.9	1.3	0.40	30
118	Piled	P	LP	Immature	Low	CT/Pile	0.0	0.0	0.0	0.5	3.4	2.3	1.9	0.0	0.0	8.1	9.8	17.9	1.3	0.50	30
119	KLC / 0.2 / Sh.	KL1	LP	Immature	Low	CT/L&S or Crush	0.0	0.0	0.0	0.5	3.4	2.3	1.9	0.0	0.0	8.1	9.8	17.9	1.3	0.30	30
120	Piled	P	LP	Immature	Medium	PCT/Pile	0.0	0.0	0.0	0.5	2.1	7.0	5.3	0.0	0.0	14.9	9.8	24.7	1.3	1.00	30
121	KMC / 0.2 / Sh.	KM1	LP	Immature	Medium	PCT/L&S or Crush	0.0	0.0	0.0	0.5	2.1	7.0	5.3	0.0	0.0	14.9	9.8	24.7	1.3	0.60	30
122	KH / 0.2 / Sh.	KH3	LP	Immature	Medium	CT/L&S or Crush	0.0	0.0	0.0	0.5	2.1	7.0	5.3	0.0	0.0	14.9	9.8	24.7	1.3	0.60	30
123	Piled	P	LP	Immature	Medium	CT/Pile	0.0	0.0	0.0	0.5	3.5	3.2	5.4	0.0	0.0	12.6	9.8	22.4	1.3	0.30	30
124	KLC / 0.2 / Sh.	KL1	LP	Immature	Medium	CT/L&S or Crush	0.0	0.0	0.0	0.5	3.5	3.2	5.4	0.0	0.0	12.6	9.8	22.4	1.3	0.20	30
125	Piled	P	LP	Immature	High	PCT/Pile	0.0	0.0	0.0	0.5	5.5	6.7	12.8	0.0	3.5	29.0	9.8	38.8	1.3	1.50	30
126	JLC / 0.2 / Sh.	JL1	LP	Immature	High	PCT/L&S or Crush	0.0	0.0	0.0	0.5	5.5	6.7	12.8	0.0	3.5	29.0	9.8	38.8	1.3	1.00	30
127	JL / 0.2 / Sh.	JL3	LP	Immature	High	CT/L&S or Crush	0.0	0.0	0.0	0.5	5.5	6.7	12.8	0.0	3.5	29.0	9.8	38.8	1.3	1.50	30
128	Piled	P	LP	Immature	High	CT/Pile	0.0	0.0	0.0	0.5	5.2	13.0	3.9	0.0	0.0	22.6	9.8	32.4	1.3	0.80	30
129	JLC / 0.2 / Sh.	JL1	LP	Immature	High	CT/L&S or Crush	0.0	0.0	0.0	0.5	5.2	13.0	3.9	0.0	0.0	22.6	9.8	32.4	1.3	0.50	30
130	KM / 0.5 / Unsh.	KM6	LP	Mature	Low	Logged	0.0	0.0	0.0	0.5	1.3	5.5	3.0	0.0	0.0	10.3	5.3	15.6	0.7	0.20	54
131	KM / 0.5 / Unsh.	KM6	LP	Mature	Low	Logged	0.0	0.0	0.0	0.5	1.3	5.5	3.0	0.0	0.0	10.3	5.3	15.6	0.7	0.20	54
132	KLC / 0.5 / Unsh.	KL4	LP	Mature	Low	Logged/Crush	0.5	0.5	1.0	0.5	1.3	5.5	3.0	0.0	0.0	10.3	5.3	16.6	0.7	0.10	54
133	KM / 0.5 / Unsh.	KM6	LP	Mature	Low	Logged/YUM	0.0	0.0	0.0	0.5	1.3	4.5	1.5	0.0	0.0	7.8	5.3	13.1	0.7	0.10	54
134	KM / 0.2 / Sh.	KM4	LP	Mature	Medium	Logged	0.0	0.0	0.0	0.5	1.7	4.1	6.5	5.2	0.0	18.0	5.3	23.3	0.7	0.30	54
135	KM / 0.2 / Sh.	KM4	LP	Mature	Medium	Logged	0.0	0.0	0.0	0.5	1.7	4.1	6.5	5.2	0.0	18.0	5.3	23.3	0.7	0.30	54
136	KLC / 0.2 / Sh.	KL1	LP	Mature	Medium	Logged/Crush	0.0	0.0	0.0	0.5	1.7	4.1	6.5	5.2	0.0	18.0	5.3	23.3	0.7	0.20	54
137	KM / 0.2 / Sh.	KM4	LP	Mature	Medium	Logged/YUM	0.0	0.0	0.0	0.5	1.7	4.1	3.5	3.2	0.0	13.0	5.3	18.3	0.7	0.20	54
138	KH / 0.2 / Sh.	KH3	LP	Mature	High	Logged	0.0	0.0	0.0	0.5	2.5	6.6	15.8	1.2	0.0	26.6	5.3	31.9	0.7	0.50	54
139	KH / 0.2 / Sh.	KH3	LP	Mature	High	Logged	0.0	0.0	0.0	0.5	2.5	6.6	15.8	1.2	0.0	26.6	5.3	31.9	0.7	0.50	54
140	KMC / 0.2 / Sh.	KM1	LP	Mature	High	Logged/Crush	0.0	0.0	0.0	0.5	2.5	6.6	15.8	1.2	0.0	26.6	5.3	31.9	0.7	0.30	54
141	KH / 0.2 / Sh.	KH3	LP	Mature	High	Logged/YUM	0.0	0.0	0.0	0.5	2.5	6.6	7.8	1.2	0.0	18.6	5.3	23.9	0.7	0.30	54

Table A-1

Fuel Loading and Stand Characteristics for Fuel Condition Classes

FCC	Deeming's Extended NFDRS Fuel Models	Carlton's IAA Fuel Models	Vegetation Type	Age Class	Loading Class	Activity Class	Fuel Loading												Duff Depth (inches)	Fuel Depth (feet)	Ladder Fuel Height (feet)
							Shrub (t/ac)	Herb (t/ac)	Total (t/ac)	1-hr (t/ac)	10-hr (t/ac)	100-hr (t/ac)	1000 (t/ac)	10000 (t/ac)	10000+ (t/ac)	Total (t/ac)	Duff (t/ac)	Total (t/ac)			
142	KM / 0.2 / Sh.	KM4	LP	Overmature	Low	Logged	0.0	0.0	0.0	0.5	2.2	3.4	2.9	0.0	0.0	9.0	5.3	14.3	0.7	0.20	45
143	KM / 0.2 / Sh.	KM4	LP	Overmature	Low	Logged	0.0	0.0	0.0	0.5	2.2	3.4	2.9	0.0	0.0	9.0	5.3	14.3	0.7	0.20	45
144	KLC / 0.2 / Sh.	KL1	LP	Overmature	Low	Logged/Crush	0.0	0.0	0.0	0.5	2.2	3.4	2.9	0.0	0.0	9.0	5.3	14.3	0.7	0.10	45
145	KM / 0.2 / Sh.	KM4	LP	Overmature	Low	Logged/YUM	0.0	0.0	0.0	0.5	2.2	2.4	1.5	0.0	0.0	6.6	5.3	11.9	0.7	0.10	45
146	KM / 0.2 / Sh.	KM4	LP	Overmature	Medium	Logged	0.0	0.0	0.0	0.5	1.7	4.1	6.5	5.2	0.0	18.0	5.3	23.3	0.7	0.30	45
147	KM / 0.2 / Sh.	KM4	LP	Overmature	Medium	Logged	0.0	0.0	0.0	0.5	1.7	4.1	6.5	5.2	0.0	18.0	5.3	23.3	0.7	0.30	45
148	KLC / 0.2 / Sh.	KL1	LP	Overmature	Medium	Logged/Crush	0.0	0.0	0.0	0.5	1.7	4.1	6.5	5.2	0.0	18.0	5.3	23.3	0.7	0.20	45
149	KM / 0.2 / Sh.	KM4	LP	Overmature	Medium	Logged/YUM	0.0	0.0	0.0	0.5	1.7	4.1	3.5	3.2	0.0	13.0	5.3	18.3	0.7	0.20	45
150	KH / 0.2 / Sh.	KH3	LP	Overmature	High	Logged	0.0	0.0	0.0	0.5	2.5	6.6	15.8	1.2	0.0	26.6	5.3	31.9	0.7	0.50	45
151	KH / 0.2 / Sh.	KH3	LP	Overmature	High	Logged	0.0	0.0	0.0	0.5	2.5	6.6	15.8	1.2	0.0	26.6	5.3	31.9	0.7	0.50	45
152	KMC / 0.2 / Sh.	KM1	LP	Overmature	High	Logged/Crush	0.0	0.0	0.0	0.5	2.5	6.6	15.8	1.2	0.0	26.6	5.3	31.9	0.7	0.30	45
153	KH / 0.2 / Sh.	KH3	LP	Overmature	High	Logged/YUM	0.0	0.0	0.0	0.5	2.5	6.6	7.8	1.2	0.0	18.6	5.3	23.9	0.7	0.30	45
154	TM / 0.5 / Unsh.	TM3	WJ	Bare	Low		2.5	0.5	3.0	0.2	0.4	0.3	0.0	0.0	0.0	0.9	1.5	5.4	0.2	1.00	-
155	TM / 0.5 / Unsh.	TM3	WJ	Bare	Medium		2.5	0.5	3.0	0.2	0.4	0.3	0.0	0.0	0.0	0.9	1.5	5.4	0.2	1.00	-
156	TM / 0.5 / Unsh.	TM3	WJ	Bare	High		2.5	0.5	3.0	0.2	0.4	0.3	0.0	0.0	0.0	0.9	1.5	5.4	0.2	1.00	-
157	TM / 0.5 / Unsh.	TM3	WJ	Immature	Low		2.5	0.5	3.0	0.2	0.4	0.3	0.0	0.0	0.0	0.9	1.5	5.4	0.2	1.00	0
158	TM / 0.5 / Unsh.	TM3	WJ	Immature	Medium		2.5	0.5	3.0	0.2	0.4	0.3	0.0	0.0	0.0	0.9	1.5	5.4	0.2	1.00	0
159	TM / 0.5 / Unsh.	TM3	WJ	Immature	High		2.5	0.5	3.0	0.2	0.4	0.3	0.0	0.0	0.0	0.9	1.5	5.4	0.2	1.00	0
160	TH / 0.5 / Unsh.	TH2	WJ	Mature	Low		3.3	0.7	4.0	0.2	0.4	0.8	0.0	0.0	0.0	1.4	2.3	7.7	0.3	1.00	1
161	TH / 0.5 / Unsh.	TH2	WJ	Mature	Medium		3.3	0.7	4.0	0.2	0.4	0.8	0.0	0.0	0.0	1.4	2.3	7.7	0.3	1.00	1
162	TH / 0.5 / Unsh.	TH2	WJ	Mature	High		3.3	0.7	4.0	0.2	0.4	0.8	0.0	0.0	0.0	1.4	2.3	7.7	0.3	1.00	1
163	AL / 0.5 / Unsh.	AL2	G	Mature	Low		0.0	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	1.0	0.1	0.80	-
164	AL / 0.2 / Sh.	AL1	G/PP	Mature	Low		0.0	0.2	0.2	0.0	0.2	0.5	0.1	0.0	0.0	0.8	7.6	8.6	1.0	0.40	23
165	SH / 0.2 / Sh.	SH1	G/LP	Mature	Low		0.7	0.7	1.4	0.4	1.1	0.7	0.8	0.0	0.0	3.0	4.5	8.9	0.6	0.40	46
166	LL / 0.5 / Unsh.	LL2	G	Mature	Medium		0.0	0.3	0.3	0.0	0.2	0.0	0.0	0.0	0.0	0.2	0.8	1.3	0.1	0.80	-
167	UL / 0.2 / Sh.	UL1	G/PP	Mature	Medium		0.4	0.3	0.7	0.1	1.5	1.2	0.8	1.7	0.0	5.3	7.6	13.6	1.0	2.00	23
168	UL / 0.2 / Sh.	UL1	G/LP	Mature	Medium		0.4	0.5	0.9	0.2	0.9	1.7	1.3	0.0	0.0	4.1	4.5	9.5	0.6	2.00	46
169	LL / 0.5 / Unsh.	LL2	G	Mature	High		0.0	0.3	0.3	0.0	0.2	0.0	0.0	0.0	0.0	0.2	0.8	1.3	0.1	0.80	-
170	UM / 0.2 / Sh.	UM1	G/PP	Mature	High		0.0	0.3	0.3	0.1	1.0	2.5	2.3	3.4	4.5	13.8	7.6	21.7	1.0	2.00	23
171	HM / 0.2 / Sh.	HM1	G/LP	Mature	High		0.5	0.5	1.0	0.2	1.0	4.1	10.7	0.8	0.0	16.8	4.5	22.3	0.6	2.00	46
172	FM / 0.3 / Unsh.	FM1	S	Immature	Low		9.0	0.0	9.0	0.1	0.7	0.8	1.7	0.0	0.0	3.3	1.5	13.8	0.2	0.25	-
173	FM / 0.3 / Unsh.	FM1	S	Immature	Medium		9.0	0.0	9.0	0.1	0.7	0.8	1.7	2.0	0.0	5.3	1.5	15.8	0.2	0.25	-
174	FM / 0.3 / Unsh.	FM1	S	Immature	High		9.0	0.0	9.0	0.3	0.8	0.8	0.5	3.6	0.0	6.0	1.5	16.5	0.2	0.25	-
175	FM / 0.3 / Unsh.	FM1	S	Mature	Low		9.0	0.0	9.0	0.3	0.8	0.8	0.5	3.6	0.0	6.0	1.5	16.5	0.2	1.25	-
176	FM / 0.3 / Unsh.	FM1	S	Mature	Medium		9.0	0.0	9.0	0.2	1.1	1.0	0.5	4.8	0.0	7.6	1.5	18.1	0.2	1.35	-
177	FM / 0.3 / Unsh.	FM1	S	Mature	High		9.0	0.0	9.0	0.2	1.2	2.3	2.3	2.4	0.0	8.0	1.5	18.5	0.2	1.25	-
178	TL / 0.2 / Sh.	TL1	S/MC	Immature	Low		1.8	0.3	2.1	0.6	2.3	1.9	2.0	0.0	0.0	6.8	13.6	22.5	1.8	1.25	14
179	TM / 0.2 / Sh.	TM1	S/MC	Immature	Medium		2.5	0.5	3.0	0.5	1.3	3.0	4.5	0.0	0.0	9.3	10.6	22.9	1.4	1.25	14
180	TH / 0.3 / Unsh.	TH1	S/MC	Immature	High		3.3	0.7	4.0	1.3	3.4	4.9	4.5	0.0	0.0	14.1	15.1	33.2	2.0	1.25	14
181	TL / 0.2 / Sh.	TL1	S/MC	Mature	Low		1.8	0.3	2.1	0.7	1.1	1.5	3.1	4.7	0.0	11.1	13.6	26.8	1.8	1.25	20
182	TM / 0.2 / Sh.	TM1	S/MC	Mature	Medium		2.5	0.5	3.0	0.5	1.8	3.5	12.3	2.3	0.0	20.4	10.6	34.0	1.4	1.25	20
183	TH / 0.3 / Unsh.	TH1	S/MC	Mature	High		3.3	0.7	4.0	0.8	2.7	2.6	10.6	13.3	0.0	30.0	15.1	49.1	2.0	1.25	20
184	TM / 0.3 / Unsh.	TM2	PP	Mature	Low-		2.5	0.5	3.0	0.1	0.4	0.7	0.4	1.0	1.0	3.6	9.8	16.4	1.3	0.10	23
185	UL / 0.3 / Unsh.	UL2	PP	Overmature	Low-		0.4	0.5	0.9	0.5	0.4	1.8	0.5	1.0	1.0	5.2	5.3	11.4	0.7	0.25	27
186	HL / 0.2 / Sh.	HL1	MC	Mature	Low-		0.4	0.3	0.7	0.6	1.3	1.4	2.0	0.0	0.0	5.3	15.9	21.9	2.1	0.20	20
187	HL / 0.2 / Sh.	HL1	MC	Overmature	Low-		0.4	0.3	0.7	0.1	0.7	0.8	1.7	2.0	1.0	6.3	20.4	27.4	2.7	0.20	40
188	HL / 0.2 / Sh.	HL1	LP	Immature	Low-		0.4	0.3	0.7	0.3	0.4	2.0	0.4	0.0	0.0	3.1	3.8	7.6	0.5	0.10	30

Table A-1

Fuel Loading and Stand Characteristics for Fuel Condition Classes

FCC	Deeming's Extended NFDRS Fuel Models	Carlton's IAA Fuel Models	Vegetation Type	Age Class	Loading Class	Activity Class	Fuel Loading Shrub (t/ac)	Herb (t/ac)	Total (t/ac)	1-hr (t/ac)	10-hr (t/ac)	100-hr (t/ac)	1000 (t/ac)	10000 (t/ac)	10000+ (t/ac)	Total (t/ac)	Duff (t/ac)	Total (t/ac)	Duff Depth (inches)	Fuel Depth (feet)	Ladder Fuel Height (feet)
1	HL / 0.4 / Unsh.	HL3	PP	Bare	Low		0.4	0.3	0.7	0.5	0.8	1.7	1.9	3.0	0.0	7.9	2.3	10.9	0.3	0.25	-
2	HM / 0.3 / Unsh.	HM2	PP	Bare	Medium		0.5	0.5	1.0	0.5	1.9	5.1	3.4	4.1	0.0	15.0	2.3	18.3	0.3	0.40	-
3	HL / 0.4 / Unsh.	HL3	PP	Bare	High		0.4	0.5	0.9	0.5	0.4	2.3	2.7	4.2	8.4	18.5	2.3	21.7	0.3	0.40	-
4	UM / 0.2 / Sh.	UM1	PP	Immature	Low		0.5	0.5	1.0	0.1	1.5	2.2	1.1	1.8	3.3	10.0	6.0	17.0	0.8	0.50	12
5	CM / 0.2 / Sh.	CM1	PP	Immature	Medium		0.5	0.8	1.3	0.1	1.5	4.8	5.5	2.3	3.3	17.5	6.0	24.8	0.8	1.00	12
6	CH / 0.2 / Sh.	CH1	PP	Immature	High		0.7	1.1	1.8	0.1	3.9	4.5	9.5	3.0	3.3	24.3	6.0	32.1	0.8	1.00	12
7	UL / 0.2 / Sh.	UL1	PP	Mature	Low		0.4	0.8	1.2	0.1	0.6	1.6	0.4	1.0	5.6	9.3	9.8	20.3	1.3	0.25	23
8	UM / 0.2 / Sh.	UM1	PP	Mature	Medium		0.0	0.0	0.0	0.1	1.6	4.2	2.1	2.9	4.7	15.6	9.8	25.4	1.3	0.50	23
9	HM / 0.2 / Sh.	HM1	PP	Mature	High		0.4	0.3	0.7	0.1	1.1	2.5	10.3	6.0	3.6	23.6	9.8	34.1	1.3	0.50	23
10	TM / 0.2 / Sh.	TM1	PP	Overmature	Low		2.5	0.5	3.0	0.2	1.2	2.3	2.3	2.4	2.0	10.4	12.8	26.2	1.7	0.50	27
11	HM / 0.2 / Sh.	HM1	PP	Overmature	Medium		0.5	0.5	1.0	0.0	1.5	4.9	10.1	6.2	4.0	26.7	12.8	40.6	1.7	1.00	27
12	UL / 0.2 / Sh.	UL1	PP	Overmature	High		0.4	0.3	0.7	0.0	0.3	1.5	6.7	22.8	9.0	40.3	12.8	53.9	1.7	1.00	27
13	Piled	P	PP	Immature	Low	PCT/Pile	0.0	0.0	0.0	0.5	3.4	2.3	1.9	0.0	0.0	8.1	8.3	16.4	1.1	0.50	12
14	KLC / 0.2 / Sh.	KL1	PP	Immature	Low	PCT/L&S or Crush	0.0	0.0	0.0	0.5	3.4	2.3	1.9	0.0	0.0	8.1	8.3	16.4	1.1	0.30	12
15	KL / 0.2 / Sh.	KL2	PP	Immature	Low	PCT or CT/NMT	0.0	0.0	0.0	0.5	3.4	2.3	1.9	0.0	0.0	8.1	8.3	16.4	1.1	0.50	12
16	Piled	P	PP	Immature	Low	CT/Pile	0.0	0.0	0.0	0.5	2.7	5.5	1.0	0.0	0.0	9.7	8.3	18.0	1.1	0.50	12
17	KLC / 0.2 / Sh.	KL1	PP	Immature	Low	CT/L&S or Crush	0.0	0.0	0.0	0.5	2.7	5.5	1.0	0.0	0.0	9.7	8.3	18.0	1.1	0.30	12
18	Piled	P	PP	Immature	Medium	PCT/Pile	0.0	0.0	0.0	0.5	5.2	7.0	3.9	0.0	0.0	16.6	8.3	24.9	1.1	1.20	12
19	JLC / 0.2 / Sh.	JL1	PP	Immature	Medium	PCT/L&S or Crush	0.0	0.0	0.0	0.5	5.2	7.0	3.9	0.0	0.0	16.6	8.3	24.9	1.1	0.75	12
20	JL / 0.2 / Sh.	JL3	PP	Immature	Medium	CT/L&S or Crush	0.0	0.0	0.0	0.5	5.2	7.0	3.9	0.0	0.0	16.6	8.3	24.9	1.1	1.20	12
21	Piled	P	PP	Immature	Medium	CT/Pile	0.0	0.0	0.0	0.5	5.2	7.0	3.9	0.0	0.0	16.6	8.3	24.9	1.1	1.20	12
22	JLC / 0.2 / Sh.	JL1	PP	Immature	Medium	CT/L&S or Crush	0.0	0.0	0.0	0.5	5.2	7.0	3.9	0.0	0.0	16.6	8.3	24.9	1.1	0.75	12
23	Piled	P	PP	Immature	High	PCT/Pile	0.0	0.0	0.0	0.5	5.5	6.7	12.8	0.0	3.5	29.0	8.3	37.3	1.1	1.80	12
24	JLC / 0.2 / Sh.	JL1	PP	Immature	High	PCT/L&S or Crush	0.0	0.0	0.0	0.5	5.5	6.7	12.8	0.0	3.5	29.0	8.3	37.3	1.1	1.00	12
25	JL / 0.2 / Sh.	JL3	PP	Immature	High	CT/L&S or Crush	0.0	0.0	0.0	0.5	5.5	6.7	12.8	0.0	3.5	29.0	8.3	37.3	1.1	1.80	12
26	Piled	P	PP	Immature	High	CT/Pile	0.0	0.0	0.0	0.5	5.5	6.7	3.9	0.0	3.5	20.1	8.3	28.4	1.1	1.00	12
27	JLC / 0.2 / Sh.	JL1	PP	Immature	High	CT/L&S or Crush	0.0	0.0	0.0	0.5	5.5	6.7	3.9	0.0	3.5	20.1	8.3	28.4	1.1	0.75	12
28	KM / 0.3 / Unsh.	KM5	PP	Mature	Low	Logged	0.0	0.0	0.0	0.5	2.7	5.0	5.7	0.0	0.0	13.9	6.0	19.9	0.8	0.30	33
29	KM / 0.3 / Unsh.	KM5	PP	Mature	Low	Logged	0.0	0.0	0.0	0.5	2.7	5.0	5.7	0.0	0.0	13.9	6.0	19.9	0.8	0.30	33
30	KLC / 0.3 / Unsh.	KL3	PP	Mature	Low	Logged/Crush	0.0	0.0	0.0	0.5	2.7	5.0	5.7	0.0	0.0	13.9	6.0	19.9	0.8	0.20	33
31	KM / 0.2 / Sh.	KM4	PP	Mature	Low	Logged/YUM	0.0	0.0	0.0	0.5	2.2	3.4	2.9	0.0	0.0	9.0	6.0	15.0	0.8	0.30	33
32	KM / 0.3 / Unsh.	KM5	PP	Mature	Medium	Logged	0.0	0.0	0.0	0.5	2.3	4.8	4.3	6.2	0.0	18.1	6.0	24.1	0.8	0.50	33
33	KM / 0.3 / Unsh.	KM5	PP	Mature	Medium	Logged	0.0	0.0	0.0	0.5	2.3	4.8	4.3	6.2	0.0	18.1	6.0	24.1	0.8	0.50	33
34	KLC / 0.3 / Unsh.	KL3	PP	Mature	Medium	Logged/Crush	0.0	0.0	0.0	0.5	2.3	4.8	4.3	6.2	0.0	18.1	6.0	24.1	0.8	0.40	33
35	KM / 0.3 / Unsh.	KM5	PP	Mature	Medium	Logged/YUM	0.0	0.0	0.0	0.5	2.7	5.0	3.7	1.0	1.0	13.9	6.0	19.9	0.8	0.50	33
36	JL / 0.3 / Unsh.	JL4	PP	Mature	High	Logged	0.0	0.0	0.0	0.5	3.8	7.4	7.1	4.6	6.6	30.0	6.0	36.0	0.8	0.50	33
37	JL / 0.3 / Unsh.	JL4	PP	Mature	High	Logged	0.0	0.0	0.0	0.5	3.8	7.4	7.1	4.6	6.6	30.0	6.0	36.0	0.8	0.50	33
38	JLC / 0.3 / Unsh.	JL2	PP	Mature	High	Logged/Crush	0.0	0.0	0.0	0.5	3.8	7.4	7.1	4.6	6.6	30.0	6.0	36.0	0.8	0.40	33
39	KM / 0.3 / Unsh.	KM5	PP	Mature	High	Logged/YUM	0.0	0.0	0.0	0.5	2.3	4.8	4.3	8.2	2.5	22.6	6.0	28.6	0.8	0.50	33
40	KM / 0.3 / Unsh.	KM5	PP	Overmature	Low	Logged	0.0	0.0	0.0	0.5	2.7	5.0	5.7	2.0	2.0	17.9	6.0	23.9	0.8	0.30	39
41	KM / 0.3 / Unsh.	KM5	PP	Overmature	Low	Logged	0.0	0.0	0.0	0.5	2.7	5.0	5.7	2.0	2.0	17.9	6.0	23.9	0.8	0.30	39
42	KLC / 0.3 / Unsh.	KL3	PP	Overmature	Low	Logged/Crush	0.0	0.0	0.0	0.5	2.7	5.0	5.7	2.0	2.0	17.9	6.0	23.9	0.8	0.20	39
43	KM / 0.3 / Unsh.	KM5	PP	Overmature	Low	Logged/YUM	0.0	0.0	0.0	0.5	2.7	5.0	5.7	0.0	0.0	13.9	6.0	19.9	0.8	0.30	39
44	KM / 0.2 / Sh.	KM4	PP	Overmature	Medium	Logged	0.0	0.0	0.0	0.5	2.4	5.1	10.2	8.6	3.0	29.8	6.0	35.8	0.8	0.50	39
45	KM / 0.2 / Sh.	KM4	PP	Overmature	Medium	Logged	0.0	0.0	0.0	0.5	2.4	5.1	10.2	8.6	3.0	29.8	6.0	35.8	0.8	0.50	39
46	KLC / 0.2 / Sh.	KL1	PP	Overmature	Medium	Logged/Crush	0.0	0.0	0.0	0.5	2.4	5.1	10.2	8.6	3.0	29.8	6.0	35.8	0.8	0.40	39
47	KM / 0.2 / Unsh.	KM4	PP	Overmature	Medium	Logged/YUM	0.0	0.0	0.0	0.5	2.3	4.8	4.3	8.2	2.5	22.6	6.0	28.6	0.8	0.50	39

Table A-1

Fuel Loading and Stand Characteristics for Fuel Condition Classes

							Fuel Loading														
FCC	Deeming's Extended NFDRS Fuel Models	Carlton's IAA Fuel Models	Vegetation Type	Age Class	Loading Class	Activity Class	Shrub (t/ac)	Herb (t/ac)	Total (t/ac)	1-hr (t/ac)	10-hr (t/ac)	100-hr (t/ac)	1000 (t/ac)	10000 (t/ac)	10000+ (t/ac)	Total (t/ac)	Duff (t/ac)	Total (t/ac)	Duff Depth (inches)	Fuel Depth (feet)	Ladder Fuel Height (feet)
48	KM / 0.5 / Unsh.	KM6	PP	Overmature	High	Logged	0.0	0.0	0.0	0.5	2.4	5.1	14.0	11.0	5.0	38.0	6.0	44.0	0.8	1.00	39
49	KM / 0.5 / Unsh.	KM6	PP	Overmature	High	Logged	0.0	0.0	0.0	0.5	2.4	5.1	14.0	11.0	5.0	38.0	6.0	44.0	0.8	1.00	39
50	KLC / 0.5 / Unsh.	KL4	PP	Overmature	High	Logged/Crush	0.0	0.0	0.0	0.5	2.4	5.1	14.0	11.0	5.0	38.0	6.0	44.0	0.8	0.70	39
51	KH / 0.3 / Unsh.	KH4	PP	Overmature	High	Logged/YUM	0.0	0.0	0.0	0.5	3.9	4.8	10.0	5.5	6.9	31.6	6.0	37.6	0.8	1.00	39
52	HM / 0.2 / Sh.	HM1	MC	Bare	Low		0.5	0.5	1.0	0.6	2.3	1.9	2.0	0.0	0.0	6.8	2.3	10.1	0.3	0.30	-
53	HM / 0.2 / Sh.	HM1	MC	Bare	Medium		0.5	0.5	1.0	0.5	1.3	3.0	4.5	1.5	0.0	10.8	2.3	14.1	0.3	0.70	-
54	HL / 0.2 / Sh.	HL1	MC	Bare	High		0.4	0.3	0.7	0.4	0.6	1.1	8.8	7.2	0.0	18.1	2.3	21.1	0.3	0.40	-
55	HM / 0.2 / Sh.	HM1	MC	Immature	Low		0.5	0.5	1.0	0.6	2.3	1.9	2.0	0.0	0.0	6.8	9.1	16.9	1.2	0.30	14
56	HM / 0.2 / Sh.	HM1	MC	Immature	Medium		0.5	0.5	1.0	0.5	1.3	3.0	4.5	1.5	0.0	10.8	9.1	20.9	1.2	0.70	14
57	HL / 0.2 / Sh.	HL1	MC	Immature	High		0.4	0.3	0.7	0.4	0.6	1.1	8.8	7.2	0.0	18.1	9.1	27.9	1.2	0.40	14
58	HL / 0.2 / Sh.	HL1	MC	Mature	Low		0.4	0.3	0.7	0.7	1.1	1.5	3.1	4.7	0.0	11.1	15.9	27.7	2.1	0.20	20
59	HH / 0.2 / Sh.	HH1	MC	Mature	Medium		0.7	0.7	1.4	0.5	1.8	3.5	12.3	2.3	0.0	20.4	15.9	37.7	2.1	0.20	20
60	HM / 0.2 / Sh.	HM1	MC	Mature	High		0.5	0.5	1.0	0.7	1.6	1.9	13.9	13.7	0.0	31.8	15.9	48.7	2.1	0.30	20
61	HL / 0.2 / Sh.	HL1	MC	Overmature	Low		0.4	0.3	0.7	0.5	1.2	1.2	2.5	5.2	2.0	12.6	20.4	33.7	2.7	0.30	40
62	CM / 0.2 / Sh.	CM1	MC	Overmature	Medium		0.5	0.8	1.3	0.5	2.6	4.3	7.0	10.5	3.0	27.9	20.4	49.6	2.7	0.30	40
63	GM / 0.2 / Sh.	GM1	MC	Overmature	High		0.5	0.5	1.0	1.2	3.0	4.1	14.9	16.5	5.0	44.7	20.4	66.1	2.7	0.80	40
64	Piled	P	MC	Immature	Low	PCT/Pile	0.0	0.0	0.0	0.5	2.7	5.5	2.3	0.0	0.0	11.0	8.3	19.3	1.1	0.70	14
65	KLC / 0.2 / Sh.	KL1	MC	Immature	Low	PCT/L&S or Crush	0.0	0.0	0.0	0.5	2.7	5.5	2.3	0.0	0.0	11.0	8.3	19.3	1.1	0.50	14
66	KM / 0.2 / Sh.	KM4	MC	Immature	Low	CT/L&S or Crush	0.0	0.0	0.0	0.5	2.7	5.5	2.3	0.0	0.0	11.0	8.3	19.3	1.1	0.70	14
67	Piled	P	MC	Immature	Low	CT/Pile	0.0	0.0	0.0	0.5	2.7	5.5	2.3	0.0	0.0	11.0	8.3	19.3	1.1	0.70	14
68	KLC / 0.2 / Sh.	KL1	MC	Immature	Low	CT/L&S or Crush	0.0	0.0	0.0	0.5	2.7	5.5	2.3	0.0	0.0	11.0	8.3	19.3	1.1	0.50	14
69	Piled	P	MC	Immature	Medium	PCT/Pile	0.0	0.0	0.0	0.5	5.2	13.0	3.9	0.0	0.0	22.6	8.3	30.9	1.1	0.80	14
70	JLC / 0.2 / Sh.	JL1	MC	Immature	Medium	PCT/L&S or Crush	0.0	0.0	0.0	0.5	5.2	13.0	3.9	0.0	0.0	22.6	8.3	30.9	1.1	0.50	14
71	JM / 0.2 / Sh.	JM2	MC	Immature	Medium	CT/L&S or Crush	0.0	0.0	0.0	0.5	5.2	13.0	3.9	0.0	0.0	22.6	8.3	30.9	1.1	0.80	14
72	Piled	P	MC	Immature	Medium	CT/Pile	0.0	0.0	0.0	0.5	2.7	5.0	5.7	0.0	0.0	13.9	8.3	22.2	1.1	0.50	14
73	KLC / 0.3 / Unsh.	KL3	MC	Immature	Medium	CT/L&S or Crush	0.0	0.0	0.0	0.5	2.7	5.0	5.7	0.0	0.0	13.9	8.3	22.2	1.1	0.30	14
74	Piled	P	MC	Immature	High	PCT/Pile	0.0	0.0	0.0	0.5	5.5	13.7	8.8	0.0	3.5	32.0	8.3	40.3	1.1	1.80	14
75	JLC / 0.2 / Sh.	JL1	MC	Immature	High	PCT/L&S or Crush	0.0	0.0	0.0	0.5	5.5	13.7	8.8	0.0	3.5	32.0	8.3	40.3	1.1	1.00	14
76	JM / 0.2 / Sh.	JM2	MC	Immature	High	CT/L&S or Crush	0.0	0.0	0.0	0.5	5.5	13.7	8.8	0.0	3.5	32.0	8.3	40.3	1.1	1.80	14
77	Piled	P	MC	Immature	High	CT/Pile	0.0	0.0	0.0	0.5	5.2	13.0	3.9	0.0	0.0	22.6	8.3	30.9	1.1	0.80	14
78	JLC / 0.2 / Sh.	JL1	MC	Immature	High	CT/L&S or Crush	0.0	0.0	0.0	0.5	5.2	13.0	3.9	0.0	0.0	22.6	8.3	30.9	1.1	0.60	14
79	JM / 0.3 / Unsh.	JM3	MC	Mature	Low	Logged	0.0	0.0	0.0	0.5	2.7	5.0	5.7	3.0	1.0	17.9	15.1	33.0	2.0	0.30	36
80	JM / 0.3 / Unsh.	JM3	MC	Mature	Low	Logged	0.0	0.0	0.0	0.5	2.7	5.0	5.7	3.0	1.0	17.9	15.1	33.0	2.0	0.30	36
81	KLC / 0.3 / Unsh.	KL3	MC	Mature	Low	Logged/Crush	0.0	0.0	0.0	0.5	2.7	5.0	5.7	3.0	1.0	17.9	15.1	33.0	2.0	0.20	36
82	KM / 0.3 / Unsh.	KM5	MC	Mature	Low	Logged/YUM	0.0	0.0	0.0	0.5	2.7	5.0	2.0	0.0	0.0	10.2	15.1	25.3	2.0	0.30	36
83	KM / 0.2 / Sh.	KM4	MC	Mature	Medium	Logged	0.0	0.0	0.0	0.5	3.2	4.8	12.3	5.4	1.0	27.2	15.1	42.3	2.0	0.60	36
84	KM / 0.2 / Sh.	KM4	MC	Mature	Medium	Logged	0.0	0.0	0.0	0.5	3.2	4.8	12.3	5.4	1.0	27.2	15.1	42.3	2.0	0.60	36
85	KLC / 0.2 / Sh.	KL1	MC	Mature	Medium	Logged/Crush	0.0	0.0	0.0	0.5	3.2	4.8	12.3	5.4	1.0	27.2	15.1	42.3	2.0	0.40	36
86	KM / 0.3 / Unsh.	KM5	MC	Mature	MED	Logged/YUM	0.0	0.0	0.0	0.5	2.3	4.8	3.3	3.2	2.5	16.6	15.1	31.7	2.0	1.00	36
87	KH / 0.3 / Unsh.	KH4	MC	Mature	High	Logged	0.0	0.0	0.0	0.5	2.1	6.3	10.3	10.8	11.6	41.6	15.1	56.7	2.0	1.00	36
88	KH / 0.3 / Unsh.	KH4	MC	Mature	High	Logged	0.0	0.0	0.0	0.5	2.1	6.3	10.3	10.8	11.6	41.6	15.1	56.7	2.0	1.00	36
89	KMC / 0.3 / Unsh.	KM2	MC	Mature	High	Logged/Crush	0.0	0.0	0.0	0.5	2.1	6.3	10.3	10.8	11.6	41.6	15.1	56.7	2.0	0.70	36
90	KH / 0.3 / Unsh.	KH4	MC	Mature	High	Logged/YUM	0.0	0.0	0.0	0.5	2.1	6.3	4.3	5.8	7.6	26.6	15.1	41.7	2.0	0.60	36
91	KM / 0.3 / Unsh.	KM5	MC	Overmature	Low	Logged	0.0	0.0	0.0	0.5	2.3	4.8	4.3	8.2	2.5	22.6	15.1	37.7	2.0	0.30	58
92	KM / 0.3 / Unsh.	KM5	MC	Overmature	Low	Logged	0.0	0.0	0.0	0.5	2.3	4.8	4.3	8.2	2.5	22.6	15.1	37.7	2.0	0.30	58
93	KM / 0.3 / Unsh.	KM5	MC	Overmature	Low	Logged/Crush	0.0	0.0	0.0	0.5	2.3	4.8	4.3	8.2	2.5	22.6	15.1	37.7	2.0	0.20	58
94	KLC / 0.3 / Unsh.	KL3	MC	Overmature	Low	Logged/YUM	0.0	0.0	0.0	0.5	2.3	4.8	2.3	4.2	1.5	15.6	15.1	30.7	2.0	0.30	58

Table A-1

Fuel Loading and Stand Characteristics for Fuel Condition Classes

FCC	Deeming's Extended NFDRS Fuel Models	Carlton's IAA Fuel Models	Vegetation Type	Age Class	Loading Class	Activity Class	Fuel Loading												Duff Depth (inches)	Fuel Depth (feet)	Ladder Fuel Height (feet)
							Shrub (t/ac)	Herb (t/ac)	Total (t/ac)	1-hr (t/ac)	10-hr (t/ac)	100-hr (t/ac)	1000 (t/ac)	10000 (t/ac)	10000+ (t/ac)	Total (t/ac)	Duff (t/ac)	Total (t/ac)			
95	KH / 0.3 / Unsh.	KH4	MC	Overmature	Medium	Logged	0.0	0.0	0.0	0.5	3.9	4.8	10.0	5.5	6.9	31.6	15.1	46.7	2.0	0.70	58
96	KH / 0.3 / Unsh.	KH4	MC	Overmature	Medium	Logged	0.0	0.0	0.0	0.5	3.9	4.8	10.0	5.5	6.9	31.6	15.1	46.7	2.0	0.70	58
97	KH / 0.3 / Unsh.	KH4	MC	Overmature	Medium	Logged/Crush	0.0	0.0	0.0	0.5	3.9	4.8	10.0	5.5	6.9	31.6	15.1	46.7	2.0	0.50	58
98	KMC / 0.3 / Unsh.	KM2	MC	Overmature	Medium	Logged/YUM	0.0	0.0	0.0	0.5	3.9	4.8	5.0	3.5	4.9	22.6	15.1	37.7	2.0	0.50	58
99	KH / 0.3 / Unsh.	KH4	MC	Overmature	High	Logged	0.0	0.0	0.0	0.5	2.1	6.3	10.3	10.8	11.6	41.6	15.1	56.7	2.0	1.00	58
100	KH / 0.3 / Unsh.	KH4	MC	Overmature	High	Logged	0.0	0.0	0.0	0.5	2.1	6.3	10.3	10.8	11.6	41.6	15.1	56.7	2.0	1.00	58
101	KH / 0.3 / Unsh.	KH4	MC	Overmature	High	Logged/Crush	0.0	0.0	0.0	0.5	2.1	6.3	10.3	10.8	11.6	41.6	15.1	56.7	2.0	0.70	58
102	KMC / 0.3 / Unsh.	KM2	MC	Overmature	High	Logged/YUM	0.0	0.0	0.0	0.5	2.1	6.3	5.3	5.8	10.0	30.0	15.1	45.1	2.0	0.70	58
103	HL / 0.3 / Unsh.	HL2	LP	Bare	Low		0.4	0.3	0.7	0.5	0.8	1.7	0.9	0.0	0.0	3.9	2.3	6.9	0.3	0.10	-
104	HL / 0.3 / Unsh.	HL2	LP	Bare	Medium		0.4	0.3	0.7	0.5	1.9	3.1	3.4	2.1	0.0	11.0	2.3	14.0	0.3	0.20	-
105	HH / 0.3 / Unsh.	HH2	LP	Bare	High		0.7	0.7	1.4	0.5	1.9	5.1	3.4	4.1	0.0	15.0	2.3	18.7	0.3	0.20	-
106	HM / 0.2 / Sh.	HM1	LP	Immature	Low		0.5	0.5	1.0	0.3	0.7	4.0	0.8	0.0	0.0	5.8	3.8	10.6	0.5	0.20	30
107	GM / 0.2 / Sh.	GM1	LP	Immature	Medium		0.5	0.5	1.0	0.4	1.2	7.4	2.1	0.0	0.0	11.1	3.8	15.9	0.5	0.40	30
108	GH / 0.2 / Sh.	GH1	LP	Immature	High		0.7	0.7	1.4	0.6	2.1	10.4	4.7	0.0	0.0	17.8	3.8	23.0	0.5	0.80	30
109	HM / 0.2 / Sh.	HM1	LP	Mature	Low		0.5	0.5	1.0	0.3	0.7	4.0	0.8	0.0	0.0	5.8	4.5	11.3	0.6	0.20	46
110	GM / 0.2 / Sh.	GM1	LP	Mature	Medium		0.5	0.5	1.0	0.7	2.3	5.9	5.1	2.0	0.0	16.0	4.5	21.5	0.6	0.30	46
111	GM / 0.2 / Sh.	GM1	LP	Mature	High		0.0	0.0	0.0	0.5	1.9	7.0	9.6	16.1	0.0	35.1	4.5	39.6	0.6	0.30	46
112	HL / 0.2 / Sh.	HL1	LP	Overmature	Low		0.4	0.3	0.7	0.2	0.9	1.7	1.3	3.0	0.0	7.1	6.0	13.8	0.8	0.10	36
113	HM / 0.2 / Sh.	HM1	LP	Overmature	Medium		0.5	0.5	1.0	0.2	1.1	3.4	14.8	3.5	0.0	23.0	6.0	30.0	0.8	0.30	36
114	GM / 0.2 / Sh.	GM1	LP	Overmature	High		0.5	0.5	1.0	0.5	1.9	7.0	14.6	16.1	0.0	40.1	6.0	47.1	0.8	0.50	36
115	Piled	P	LP	Immature	Low	PCT/Pile	0.0	0.0	0.0	0.5	2.4	2.3	1.9	0.0	0.0	7.1	9.8	16.9	1.3	0.40	30
116	KLC / 0.2 / Sh.	KL1	LP	Immature	Low	PCT/L&S or Crush	0.0	0.0	0.0	0.5	2.4	2.3	1.9	0.0	0.0	7.1	9.8	16.9	1.3	0.30	30
117	KL / 0.2 / Sh.	KL2	LP	Immature	Low	CT/L&S or Crush	0.0	0.0	0.0	0.5	2.4	2.3	1.9	0.0	0.0	7.1	9.8	16.9	1.3	0.40	30
118	Piled	P	LP	Immature	Low	CT/Pile	0.0	0.0	0.0	0.5	3.4	2.3	1.9	0.0	0.0	8.1	9.8	17.9	1.3	0.50	30
119	KLC / 0.2 / Sh.	KL1	LP	Immature	Low	CT/L&S or Crush	0.0	0.0	0.0	0.5	3.4	2.3	1.9	0.0	0.0	8.1	9.8	17.9	1.3	0.30	30
120	Piled	P	LP	Immature	Medium	PCT/Pile	0.0	0.0	0.0	0.5	2.1	7.0	5.3	0.0	0.0	14.9	9.8	24.7	1.3	1.00	30
121	KMC / 0.2 / Sh.	KM1	LP	Immature	Medium	PCT/L&S or Crush	0.0	0.0	0.0	0.5	2.1	7.0	5.3	0.0	0.0	14.9	9.8	24.7	1.3	0.60	30
122	KH / 0.2 / Sh.	KH3	LP	Immature	Medium	CT/L&S or Crush	0.0	0.0	0.0	0.5	2.1	7.0	5.3	0.0	0.0	14.9	9.8	24.7	1.3	0.60	30
123	Piled	P	LP	Immature	Medium	CT/Pile	0.0	0.0	0.0	0.5	3.5	3.2	5.4	0.0	0.0	12.6	9.8	22.4	1.3	0.30	30
124	KLC / 0.2 / Sh.	KL1	LP	Immature	Medium	CT/L&S or Crush	0.0	0.0	0.0	0.5	3.5	3.2	5.4	0.0	0.0	12.6	9.8	22.4	1.3	0.20	30
125	Piled	P	LP	Immature	High	PCT/Pile	0.0	0.0	0.0	0.5	5.5	6.7	12.8	0.0	3.5	29.0	9.8	38.8	1.3	1.50	30
126	JLC / 0.2 / Sh.	JL1	LP	Immature	High	PCT/L&S or Crush	0.0	0.0	0.0	0.5	5.5	6.7	12.8	0.0	3.5	29.0	9.8	38.8	1.3	1.00	30
127	JL / 0.2 / Sh.	JL3	LP	Immature	High	CT/L&S or Crush	0.0	0.0	0.0	0.5	5.5	6.7	12.8	0.0	3.5	29.0	9.8	38.8	1.3	1.50	30
128	Piled	P	LP	Immature	High	CT/Pile	0.0	0.0	0.0	0.5	5.2	13.0	3.9	0.0	0.0	22.6	9.8	32.4	1.3	0.80	30
129	JLC / 0.2 / Sh.	JL1	LP	Immature	High	CT/L&S or Crush	0.0	0.0	0.0	0.5	5.2	13.0	3.9	0.0	0.0	22.6	9.8	32.4	1.3	0.50	30
130	KM / 0.5 / Unsh.	KM6	LP	Mature	Low	Logged	0.0	0.0	0.0	0.5	1.3	5.5	3.0	0.0	0.0	10.3	5.3	15.6	0.7	0.20	54
131	KM / 0.5 / Unsh.	KM6	LP	Mature	Low	Logged	0.0	0.0	0.0	0.5	1.3	5.5	3.0	0.0	0.0	10.3	5.3	15.6	0.7	0.20	54
132	KLC / 0.5 / Unsh.	KL4	LP	Mature	Low	Logged/Crush	0.5	0.5	1.0	0.5	1.3	5.5	3.0	0.0	0.0	10.3	5.3	16.6	0.7	0.10	54
133	KM / 0.5 / Unsh.	KM6	LP	Mature	Low	Logged/YUM	0.0	0.0	0.0	0.5	1.3	4.5	1.5	0.0	0.0	7.8	5.3	13.1	0.7	0.10	54
134	KM / 0.2 / Sh.	KM4	LP	Mature	Medium	Logged	0.0	0.0	0.0	0.5	1.7	4.1	6.5	5.2	0.0	18.0	5.3	23.3	0.7	0.30	54
135	KM / 0.2 / Sh.	KM4	LP	Mature	Medium	Logged	0.0	0.0	0.0	0.5	1.7	4.1	6.5	5.2	0.0	18.0	5.3	23.3	0.7	0.30	54
136	KLC / 0.2 / Sh.	KL1	LP	Mature	Medium	Logged/Crush	0.0	0.0	0.0	0.5	1.7	4.1	6.5	5.2	0.0	18.0	5.3	23.3	0.7	0.20	54
137	KM / 0.2 / Sh.	KM4	LP	Mature	Medium	Logged/YUM	0.0	0.0	0.0	0.5	1.7	4.1	3.5	3.2	0.0	13.0	5.3	18.3	0.7	0.20	54
138	KH / 0.2 / Sh.	KH3	LP	Mature	High	Logged	0.0	0.0	0.0	0.5	2.5	6.6	15.8	1.2	0.0	26.6	5.3	31.9	0.7	0.50	54
139	KH / 0.2 / Sh.	KH3	LP	Mature	High	Logged	0.0	0.0	0.0	0.5	2.5	6.6	15.8	1.2	0.0	26.6	5.3	31.9	0.7	0.50	54
140	KMC / 0.2 / Sh.	KM1	LP	Mature	High	Logged/Crush	0.0	0.0	0.0	0.5	2.5	6.6	15.8	1.2	0.0	26.6	5.3	31.9	0.7	0.30	54
141	KH / 0.2 / Sh.	KH3	LP	Mature	High	Logged/YUM	0.0	0.0	0.0	0.5	2.5	6.6	7.8	1.2	0.0	18.6	5.3	23.9	0.7	0.30	54

Table A-1

Fuel Loading and Stand Characteristics for Fuel Condition Classes

FCC	Deeming's Extended NFDRS Fuel Models	Carlton's IAA Fuel Models	Vegetation Type	Age Class	Loading Class	Activity Class	Fuel Loading Shrub (t/ac)	Herb (t/ac)	Total (t/ac)	1-hr (t/ac)	10-hr (t/ac)	100-hr (t/ac)	1000 (t/ac)	10000 (t/ac)	10000+ (t/ac)	Total (t/ac)	Duff (t/ac)	Total (t/ac)	Duff Depth (inches)	Fuel Depth (feet)	Ladder Fuel Height (feet)
142	KM / 0.2 / Sh.	KM4	LP	Overmature	Low	Logged	0.0	0.0	0.0	0.5	2.2	3.4	2.9	0.0	0.0	9.0	5.3	14.3	0.7	0.20	45
143	KM / 0.2 / Sh.	KM4	LP	Overmature	Low	Logged	0.0	0.0	0.0	0.5	2.2	3.4	2.9	0.0	0.0	9.0	5.3	14.3	0.7	0.20	45
144	KLC / 0.2 / Sh.	KL1	LP	Overmature	Low	Logged/Crush	0.0	0.0	0.0	0.5	2.2	3.4	2.9	0.0	0.0	9.0	5.3	14.3	0.7	0.10	45
145	KM / 0.2 / Sh.	KM4	LP	Overmature	Low	Logged/YUM	0.0	0.0	0.0	0.5	2.2	2.4	1.5	0.0	0.0	6.6	5.3	11.9	0.7	0.10	45
146	KM / 0.2 / Sh.	KM4	LP	Overmature	Medium	Logged	0.0	0.0	0.0	0.5	1.7	4.1	6.5	5.2	0.0	18.0	5.3	23.3	0.7	0.30	45
147	KM / 0.2 / Sh.	KM4	LP	Overmature	Medium	Logged	0.0	0.0	0.0	0.5	1.7	4.1	6.5	5.2	0.0	18.0	5.3	23.3	0.7	0.30	45
148	KLC / 0.2 / Sh.	KL1	LP	Overmature	Medium	Logged/Crush	0.0	0.0	0.0	0.5	1.7	4.1	6.5	5.2	0.0	18.0	5.3	23.3	0.7	0.20	45
149	KM / 0.2 / Sh.	KM4	LP	Overmature	Medium	Logged/YUM	0.0	0.0	0.0	0.5	1.7	4.1	3.5	3.2	0.0	13.0	5.3	18.3	0.7	0.20	45
150	KH / 0.2 / Sh.	KH3	LP	Overmature	High	Logged	0.0	0.0	0.0	0.5	2.5	6.6	15.8	1.2	0.0	26.6	5.3	31.9	0.7	0.50	45
151	KH / 0.2 / Sh.	KH3	LP	Overmature	High	Logged	0.0	0.0	0.0	0.5	2.5	6.6	15.8	1.2	0.0	26.6	5.3	31.9	0.7	0.50	45
152	KMC / 0.2 / Sh.	KM1	LP	Overmature	High	Logged/Crush	0.0	0.0	0.0	0.5	2.5	6.6	15.8	1.2	0.0	26.6	5.3	31.9	0.7	0.30	45
153	KH / 0.2 / Sh.	KH3	LP	Overmature	High	Logged/YUM	0.0	0.0	0.0	0.5	2.5	6.6	7.8	1.2	0.0	18.6	5.3	23.9	0.7	0.30	45
154	TM / 0.5 / Unsh.	TM3	WJ	Bare	Low		2.5	0.5	3.0	0.2	0.4	0.3	0.0	0.0	0.0	0.9	1.5	5.4	0.2	1.00	-
155	TM / 0.5 / Unsh.	TM3	WJ	Bare	Medium		2.5	0.5	3.0	0.2	0.4	0.3	0.0	0.0	0.0	0.9	1.5	5.4	0.2	1.00	-
156	TM / 0.5 / Unsh.	TM3	WJ	Bare	High		2.5	0.5	3.0	0.2	0.4	0.3	0.0	0.0	0.0	0.9	1.5	5.4	0.2	1.00	-
157	TM / 0.5 / Unsh.	TM3	WJ	Immature	Low		2.5	0.5	3.0	0.2	0.4	0.3	0.0	0.0	0.0	0.9	1.5	5.4	0.2	1.00	0
158	TM / 0.5 / Unsh.	TM3	WJ	Immature	Medium		2.5	0.5	3.0	0.2	0.4	0.3	0.0	0.0	0.0	0.9	1.5	5.4	0.2	1.00	0
159	TM / 0.5 / Unsh.	TM3	WJ	Immature	High		2.5	0.5	3.0	0.2	0.4	0.3	0.0	0.0	0.0	0.9	1.5	5.4	0.2	1.00	0
160	TH / 0.5 / Unsh.	TH2	WJ	Mature	Low		3.3	0.7	4.0	0.2	0.4	0.8	0.0	0.0	0.0	1.4	2.3	7.7	0.3	1.00	1
161	TH / 0.5 / Unsh.	TH2	WJ	Mature	Medium		3.3	0.7	4.0	0.2	0.4	0.8	0.0	0.0	0.0	1.4	2.3	7.7	0.3	1.00	1
162	TH / 0.5 / Unsh.	TH2	WJ	Mature	High		3.3	0.7	4.0	0.2	0.4	0.8	0.0	0.0	0.0	1.4	2.3	7.7	0.3	1.00	1
163	AL / 0.5 / Unsh.	AL2	G	Mature	Low		0.0	0.2	0.2	0.0	0:0	0.0	0.0	0.0	0.0	0.0	0.8	1.0	0.1	0.80	-
164	AL / 0.2 / Sh.	AL1	G/PP	Mature	Low		0.0	0.2	0.2	0.0	0.2	0.5	0.1	0.0	0.0	0.8	7.6	8.6	1.0	0.40	23
165	SH / 0.2 / Sh.	SH1	G/LP	Mature	Low		0.7	0.7	1.4	0.4	1.1	0.7	0.8	0.0	0.0	3.0	4.5	8.9	0.6	0.40	46
166	LL / 0.5 / Unsh.	LL2	G	Mature	Medium		0.0	0.3	0.3	0.0	0.2	0.0	0.0	0.0	0.0	0.2	0.8	1.3	0.1	0.80	-
167	UL / 0.2 / Sh.	UL1	G/PP	Mature	Medium		0.4	0.3	0.7	0.1	1.5	1.2	0.8	1.7	0.0	5.3	7.6	13.6	1.0	2.00	23
168	UL / 0.2 / Sh.	UL1	G/LP	Mature	Medium		0.4	0.5	0.9	0.2	0.9	1.7	1.3	0.0	0.0	4.1	4.5	9.5	0.6	2.00	46
169	LL / 0.5 / Unsh.	LL2	G	Mature	High		0.0	0.3	0.3	0.0	0.2	0.0	0.0	0.0	0.0	0.2	0.8	1.3	0.1	0.80	-
170	UM / 0.2 / Sh.	UM1	G/PP	Mature	High		0.0	0.3	0.3	0.1	1.0	2.5	2.3	3.4	4.5	13.8	7.6	21.7	1.0	2.00	23
171	HM / 0.2 / Sh.	HM1	G/LP	Mature	High		0.5	0.5	1.0	0.2	1.0	4.1	10.7	0.8	0.0	16.8	4.5	22.3	0.6	2.00	46
172	FM / 0.3 / Unsh.	FM1	S	Immature	Low		9.0	0.0	9.0	0.1	0.7	0.8	1.7	0.0	0.0	3.3	1.5	13.8	0.2	0.25	-
173	FM / 0.3 / Unsh.	FM1	S	Immature	Medium		9.0	0.0	9.0	0.1	0.7	0.8	1.7	2.0	0.0	5.3	1.5	15.8	0.2	0.25	-
174	FM / 0.3 / Unsh.	FM1	S	Immature	High		9.0	0.0	9.0	0.3	0.8	0.8	0.5	3.6	0.0	6.0	1.5	16.5	0.2	0.25	-
175	FM / 0.3 / Unsh.	FM1	S	Mature	Low		9.0	0.0	9.0	0.3	0.8	0.8	0.5	3.6	0.0	6.0	1.5	16.5	0.2	1.25	-
176	FM / 0.3 / Unsh.	FM1	S	Mature	Medium		9.0	0.0	9.0	0.2	1.1	1.0	0.5	4.8	0.0	7.6	1.5	18.1	0.2	1.35	-
177	FM / 0.3 / Unsh.	FM1	S	Mature	High		9.0	0.0	9.0	0.2	1.2	2.3	2.3	2.4	0.0	8.0	1.5	18.5	0.2	1.25	-
178	TL / 0.2 / Sh.	TL1	S/MC	Immature	Low		1.8	0.3	2.1	0.6	2.3	1.9	2.0	0.0	0.0	6.8	13.6	22.5	1.8	1.25	14
179	TM / 0.2 / Sh.	TM1	S/MC	Immature	Medium		2.5	0.5	3.0	0.5	1.3	3.0	4.5	0.0	0.0	9.3	10.6	22.9	1.4	1.25	14
180	TH / 0.3 / Unsh.	TH1	S/MC	Immature	High		3.3	0.7	4.0	1.3	3.4	4.9	4.5	0.0	0.0	14.1	15.1	33.2	2.0	1.25	14
181	TL / 0.2 / Sh.	TL1	S/MC	Mature	Low		1.8	0.3	2.1	0.7	1.1	1.5	3.1	4.7	0.0	11.1	13.6	26.8	1.8	1.25	20
182	TM / 0.2 / Sh.	TM1	S/MC	Mature	Medium		2.5	0.5	3.0	0.5	1.8	3.5	12.3	2.3	0.0	20.4	10.6	34.0	1.4	1.25	20
183	TH / 0.3 / Unsh.	TH1	S/MC	Mature	High		3.3	0.7	4.0	0.8	2.7	2.6	10.6	13.3	0.0	30.0	15.1	49.1	2.0	1.25	20
184	TM / 0.3 / Unsh.	TM2	PP	Mature	Low-		2.5	0.5	3.0	0.1	0.4	0.7	0.4	1.0	1.0	3.6	9.8	16.4	1.3	0.10	23
185	UL / 0.3 / Unsh.	UL2	PP	Overmature	Low-		0.4	0.5	0.9	0.5	0.4	1.8	0.5	1.0	1.0	5.2	5.3	11.4	0.7	0.25	27
186	HL / 0.2 / Sh.	HL1	MC	Mature	Low-		0.4	0.3	0.7	0.6	1.3	1.4	2.0	0.0	0.0	5.3	15.9	21.9	2.1	0.20	20
187	HL / 0.2 / Sh.	HL1	MC	Overmature	Low-		0.4	0.3	0.7	0.1	0.7	0.8	1.7	2.0	1.0	6.3	20.4	27.4	2.7	0.20	40
188	HL / 0.2 / Sh.	HL1	LP	Immature	Low-		0.4	0.3	0.7	0.3	0.4	2.0	0.4	0.0	0.0	3.1	3.8	7.6	0.5	0.10	30

pcFIRDAT Program

pcFIRDAT is a PC-based version of the FIRDAT fire behavior model, one of the three component routines in the USDA Forest Service's FIRE FAMILY program. The pcFIRDAT program was recently developed by the California Division of Forestry (CDF, 1994). FIRDAT (and pcFIRDAT) combines fire weather station attributes (e.g., elevation, latitude, surrounding fuel types, slope) with daily weather records and the equations of the National Fire Danger Rating System. The daily weather records for specific station locations are obtained from the National Interagency Fire Management Integrated Database (NIFMID) at the USDA's National Computer Center in Kansas City. Output from the pcFIRDAT routine produces frequency distributions, tables, and graphs of the NFDRS indices and components.

One such output component is the *spread component* (Rothermel, 1972), a measure of the forward rate of spread measured in feet per minute. The spread component algorithm integrates the effects of wind, slope, and fuel bed and fuel particle properties to predict the forward rate of fire spread. In the calculation of the spread component, the slope class and fuel model (which specifies the fuel particle and fuel bed characteristics) are constants. The daily variations in the spread component are therefore caused by changes in the wind and moisture contents of the live fuels and the dead fuel timelag classes (e.g., 1-hour, 10-hour, 100-hour fuels). Often, the values of the spread component are converted to rate of spread (ROS) measured in chains per hour. One foot per minute is approximately 0.91 chains per hour.

Fire Weather Data Files Used in pcFIRDAT Runs

For this investigation, fire weather data from two weather stations, Johnson Ridge (NFDRS #351414, RAWS #3262673A) and Johnson Rock (NFDRS #351404), were used. Both stations are located well within the Grande Ronde River Basin. The Johnson Rock station is located at the summit of Johnson Rock at the Johnson Rock Lookout, elevation 5,714 feet above mean sea level (msl). The Johnson Ridge station is located approximately 1 mile southwest of Johnson Rock on a southeast aspect at an elevation of approximately 5,180 feet above msl. The Johnson Rock station was operated seasonally from 1975 through 1986, and then replaced in late 1986 by the Johnson Ridge RAWS station (Note: data from Johnson Rock continued to be recorded through October 1989).

Data from both stations were obtained from NIFMID and then merged to span the period from June 1975 through October 1993. The combined weather file was then truncated to include weather records only for the period from June 15 through October 31. A total of 1,816 fire weather records (days) were included in the final data set. No attempt was made to "fill in" or otherwise modify the contents of the fire weather file.

pcFIRDAT Lead Card Information Needs

General information needed to run the pcFIRDAT model was obtained from Tom Wordell, La Grande Ranger District, Wallowa-Whitman National Forest. This information included: fire weather station name, elevation, and latitude; NFDRS model (A-L and N-U, 1978 or

1988); NFDRS slope class, herbaceous cover class, and shrub class; the beginning and end of the fire season; and the output indices and components requested, among others.

The information obtained was localized to reflect conditions at the Johnson Ridge RAWS station (e.g., elevation, aspect, latitude). Slope class 2, climate class 2, and perennial vegetation were assumed for all runs.

Estimating Fire Spread Rates from pcFIRDAT Outputs

The pcFIRDAT model was run for each of the 49 extended NFDRS fuel models assigned to the 188 FCCs. The resulting cumulative frequency distributions of the spread component were used to determine the percentile levels (described below) representing the three fire weather classes–extreme, very high, and high–evaluated in the FETM model. The fire spread rates corresponding to each of the three fire weather classes were then determined for each of the 49 extended NFDRS fuel models. This produced a total of 147 different spread rates (49 x 3), which were then mapped into 564 positions in the fire spread rate matrix (188 x 3).

The approach used to define the three fire weather classes is described below. For each of the pcFIRDAT-generated cumulative frequency distributions of the.spread component, three regions corresponding to the three fire weather classes were identified:

1. The "vertical" region on the upper "S" bend of the distribution, corresponding to the approximately 99th-100th percentile spread component. This region was used to characterize the fire spread rates during extreme fire weather conditions.

2. The "breaking" region of the upper "S" bend of the distribution, corresponding to the approximately 90th-99th percentile spread component. This region was used to characterize the fire spread rates during very high fire weather conditions.

3. The "bench" region between the upper and lower "S" bends of the distribution, corresponding to the approximately 40th-90th percentile spread components. This region was used to characterize the fire spread rates during high fire weather conditions.

The midpoint values of the spread component for each of these ranges was used to characterize the fire spread rate (in feet per minute) by fire weather class. The midpoints corresponded roughly to the 99.5th, 94.5th, and 65th percentile spread components for the extreme, very high, and high fire weather classes, respectively.

The spread component values extracted from the 49 curves are summarized by FCC in columns 10, 11, and 12 of Table B-1. These SC values were input to the FETM model as three separate 188 x 1 column matrices, one for each fire weather class: "extremeSpreadComponent.cmx", "veryhighSpreadComponent.cmx", and "highSpreadComponent.cmx". In the FETM model, the spread components are converted to chains per hour prior to use in any calculations.

Appendix B

FETM Inputs for the Grande Ronde River Basin, Oregon

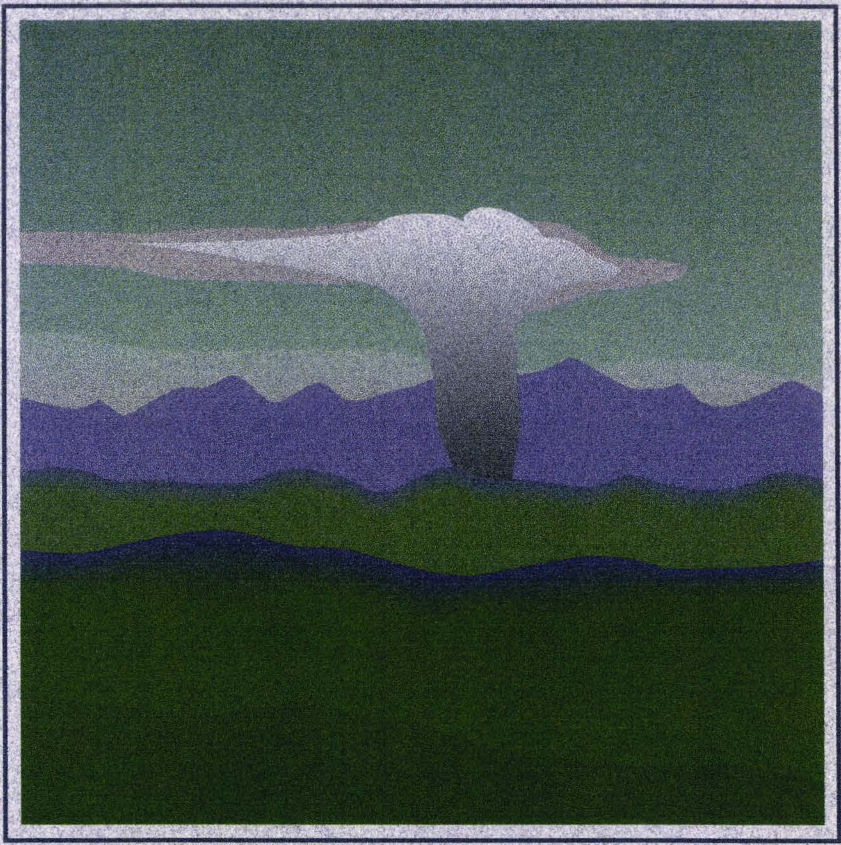


Table B-1 Fuel Condition Classes Represented in Grande Ronde River Basin				
FCC	**Vegetation Type**	**Age Class**	**Loading Class**	**Activity Class**
1	Ponderosa Pine	Bare	Low	
2	Ponderosa Pine	Bare	Medium	
3	Ponderosa Pine	Bare	High	
4	Ponderosa Pine	Immature	Low	
5	Ponderosa Pine	Immature	Medium	
6	Ponderosa Pine	Immature	High	
7	Ponderosa Pine	Mature	Low	
8	Ponderosa Pine	Mature	Medium	
9	Ponderosa Pine	Mature	High	
10	Ponderosa Pine	Overmature	Low	
11	Ponderosa Pine	Overmature	Medium	
12	Ponderosa Pine	Overmature	High	
13	Ponderosa Pine	Immature	Low	PCT/Pile
14	Ponderosa Pine	Immature	Low	PCT/L&S or Crush
15	Ponderosa Pine	Immature	Low	PCT or CT/NMT
16	Ponderosa Pine	Immature	Low	CT/Pile
17	Ponderosa Pine	Immature	Low	CT/L&S or Crush
18	Ponderosa Pine	Immature	Medium	PCT/Pile
19	Ponderosa Pine	Immature	Medium	PCT/L&S or Crush
20	Ponderosa Pine	Immature	Medium	PCT or CT/NMT
21	Ponderosa Pine	Immature	Medium	CT/Pile
22	Ponderosa Pine	Immature	Medium	CT/L&S or Crush
23	Ponderosa Pine	Immature	High	PCT/Pile
24	Ponderosa Pine	Immature	High	PCT/L&S or Crush
25	Ponderosa Pine	Immature	High	PCT or CT/NMT
26	Ponderosa Pine	Immature	High	CT/Pile
27	Ponderosa Pine	Immature	High	CT/L&S or Crush
28	Ponderosa Pine	Mature	Low	Logged
29	Ponderosa Pine	Mature	Low	Logged/NMT
30	Ponderosa Pine	Mature	Low	Logged/Crush
31	Ponderosa Pine	Mature	Low	Logged/YUM or TA
32	Ponderosa Pine	Mature	Medium	Logged
33	Ponderosa Pine	Mature	Medium	Logged/NMT
34	Ponderosa Pine	Mature	Medium	Logged/Crush
35	Ponderosa Pine	Mature	Medium	Logged/YUM or TA
36	Ponderosa Pine	Mature	High	Logged
37	Ponderosa Pine	Mature	High	Logged/NMT
38	Ponderosa Pine	Mature	High	Logged/Crush
39	Ponderosa Pine	Mature	High	Logged/YUM or TA
40	Ponderosa Pine	Overmature	Low	Logged
41	Ponderosa Pine	Overmature	Low	Logged/NMT
42	Ponderosa Pine	Overmature	Low	Logged/Crush

Table B-1 Fuel Condition Classes Represented in Grande Ronde River Basin				
FCC	**Vegetation Type**	**Age Class**	**Loading Class**	**Activity Class**
43	Ponderosa Pine	Overmature	Low	Logged/YUM or TA
44	Ponderosa Pine	Overmature	Medium	Logged
45	Ponderosa Pine	Overmature	Medium	Logged/NMT
46	Ponderosa Pine	Overmature	Medium	Logged/Crush
47	Ponderosa Pine	Overmature	Medium	Logged/YUM or TA
48	Ponderosa Pine	Overmature	High	Logged
49	Ponderosa Pine	Overmature	High	Logged/NMT
50	Ponderosa Pine	Overmature	High	Logged/Crush
51	Ponderosa Pine	Overmature	High	Logged/YUM or TA
52	Mixed Conifer	Bare	Low	
53	Mixed Conifer	Bare	Medium	
54	Mixed Conifer	Bare	High	
55	Mixed Conifer	Immature	Low	
56	Mixed Conifer	Immature	Medium	
57	Mixed Conifer	Immature	High	
58	Mixed Conifer	Mature	Low	
59	Mixed Conifer	Mature	Medium	
60	Mixed Conifer	Mature	High	
61	Mixed Conifer	Overmature	Low	
62	Mixed Conifer	Overmature	Medium	
63	Mixed Conifer	Overmature	High	
64	Mixed Conifer	Immature	Low	PCT/Pile
65	Mixed Conifer	Immature	Low	PCT/L&S or Crush
66	Mixed Conifer	Immature	Low	PCT or CT/NMT
67	Mixed Conifer	Immature	Low	CT/Pile
68	Mixed Conifer	Immature	Low	CT/L&S or Crush
69	Mixed Conifer	Immature	Medium	PCT/Pile
70	Mixed Conifer	Immature	Medium	PCT/L&S or Crush
71	Mixed Conifer	Immature	Medium	PCT or CT/NMT
72	Mixed Conifer	Immature	Medium	CT/Pile
73	Mixed Conifer	Immature	Medium	CT/L&S or Crush
74	Mixed Conifer	Immature	High	PCT/Pile
75	Mixed Conifer	Immature	High	PCT/L&S or Crush
76	Mixed Conifer	Immature	High	PCT or CT/NMT
77	Mixed Conifer	Immature	High	CT/Pile
78	Mixed Conifer	Immature	High	CT/L&S or Crush
79	Mixed Conifer	Mature	Low	Logged
80	Mixed Conifer	Mature	Low	Logged/NMT
81	Mixed Conifer	Mature	Low	Logged/Crush
82	Mixed Conifer	Mature	Low	Logged/YUM or TA
83	Mixed Conifer	Mature	Medium	Logged
84	Mixed Conifer	Mature	Medium	Logged/NMT
85	Mixed Conifer	Mature	Medium	Logged/Crush

Table B-1 Fuel Condition Classes Represented in Grande Ronde River Basin				
FCC	**Vegetation Type**	**Age Class**	**Loading Class**	**Activity Class**
86	Mixed Conifer	Mature	Medium	Logged/YUM or TA
87	Mixed Conifer	Mature	High	Logged
88	Mixed Conifer	Mature	High	Logged/NMT
89	Mixed Conifer	Mature	High	Logged/Crush
90	Mixed Conifer	Mature	High	Logged/YUM or TA
91	Mixed Conifer	Overmature	Low	Logged
92	Mixed Conifer	Overmature	Low	Logged/NMT
93	Mixed Conifer	Overmature	Low	Logged/Crush
94	Mixed Conifer	Overmature	Low	Logged/YUM or TA
95	Mixed Conifer	Overmature	Medium	Logged
96	Mixed Conifer	Overmature	Medium	Logged/NMT
97	Mixed Conifer	Overmature	Medium	Logged/Crush
98	Mixed Conifer	Overmature	Medium	Logged/YUM or TA
99	Mixed Conifer	Overmature	High	Logged
100	Mixed Conifer	Overmature	High	Logged/NMT
101	Mixed Conifer	Overmature	High	Logged/Crush
102	Mixed Conifer	Overmature	High	Logged/YUM or TA
103	Lodgepole Pine	Bare	Low	
104	Lodgepole Pine	Bare	Medium	
105	Lodgepole Pine	Bare	High	
106	Lodgepole Pine	Immature	Low	
107	Lodgepole Pine	Immature	Medium	
108	Lodgepole Pine	Immature	High	
109	Lodgepole Pine	Mature	Low	
110	Lodgepole Pine	Mature	Medium	
111	Lodgepole Pine	Mature	High	
112	Lodgepole Pine	Overmature	Low	
113	Lodgepole Pine	Overmature	Medium	
114	Lodgepole Pine	Overmature	High	
115	Lodgepole Pine	Immature	Low	PCT/Pile
116	Lodgepole Pine	Immature	Low	PCT/L&S or Crush
117	Lodgepole Pine	Immature	Low	PCT or CT/NMT
118	Lodgepole Pine	Immature	Low	CT/Pile
119	Lodgepole Pine	Immature	Low	CT/L&S or Crush
120	Lodgepole Pine	Immature	Medium	PCT/Pile
121	Lodgepole Pine	Immature	Medium	PCT/L&S or Crush
122	Lodgepole Pine	Immature	Medium	PCT or CT/NMT
123	Lodgepole Pine	Immature	Medium	CT/Pile
124	Lodgepole Pine	Immature	Medium	CT/L&S or Crush
125	Lodgepole Pine	Immature	High	PCT/Pile
126	Lodgepole Pine	Immature	High	PCT/L&S or Crush
127	Lodgepole Pine	Immature	High	PCT or CT/NMT
128	Lodgepole Pine	Immature	High	CT/Pile

Table B-1
Fuel Condition Classes Represented in Grande Ronde River Basin

FCC	Vegetation Type	Age Class	Loading Class	Activity Class
129	Lodgepole Pine	Immature	High	CT/L&S or Crush
130	Lodgepole Pine	Mature	Low	Logged
131	Lodgepole Pine	Mature	Low	Logged/NMT
132	Lodgepole Pine	Mature	Low	Logged/Crush
133	Lodgepole Pine	Mature	Low	Logged/YUM or TA
134	Lodgepole Pine	Mature	Medium	Logged
135	Lodgepole Pine	Mature	Medium	Logged/NMT
136	Lodgepole Pine	Mature	Medium	Logged/Crush
137	Lodgepole Pine	Mature	Medium	Logged/YUM or TA
138	Lodgepole Pine	Mature	High	Logged
139	Lodgepole Pine	Mature	High	Logged/NMT
140	Lodgepole Pine	Mature	High	Logged/Crush
141	Lodgepole Pine	Mature	High	Logged/YUM or TA
142	Lodgepole Pine	Overmature	Low	Logged
143	Lodgepole Pine	Overmature	Low	Logged/NMT
144	Lodgepole Pine	Overmature	Low	Logged/Crush
145	Lodgepole Pine	Overmature	Low	Logged/YUM or TA
146	Lodgepole Pine	Overmature	Medium	Logged
147	Lodgepole Pine	Overmature	Medium	Logged/NMT
148	Lodgepole Pine	Overmature	Medium	Logged/Crush
149	Lodgepole Pine	Overmature	Medium	Logged/YUM or TA
150	Lodgepole Pine	Overmature	High	Logged
151	Lodgepole Pine	Overmature	High	Logged/NMT
152	Lodgepole Pine	Overmature	High	Logged/Crush
153	Lodgepole Pine	Overmature	High	Logged/YUM or TA
154	Western Juniper	Bare	Low	
155	Western Juniper	Bare	Medium	
156	Western Juniper	Bare	High	
157	Western Juniper	Immature	Low	
158	Western Juniper	Immature	Medium	
159	Western Juniper	Immature	High	
160	Western Juniper	Mature	Low	
161	Western Juniper	Mature	Medium	
162	Western Juniper	Mature	High	
163	Grass	Mature	Low	
164	Grass/Ponderosa Pine	Mature	Low	
165	Grass/Lodgepole Pine	Mature	Low	
166	Grass	Mature	Medium	
167	Grass/Ponderosa Pine	Mature	Medium	
168	Grass/Lodgepole Pine	Mature	Medium	
169	Grass	Mature	High	
170	Grass/Ponderosa Pine	Mature	High	
171	Grass/Lodgepole Pine	Mature	High	

Table B-1 Fuel Condition Classes Represented in Grande Ronde River Basin				
FCC	**Vegetation Type**	**Age Class**	**Loading Class**	**Activity Class**
172	Shrub	Immature	Low	
173	Shrub	Immature	Medium	
174	Shrub	Immature	High	
175	Shrub	Mature	Low	
176	Shrub	Mature	Medium	
177	Shrub	Mature	High	
178	Shrub/Mixed Conifer	Immature	Low	
179	Shrub/Mixed Conifer	Immature	Medium	
180	Shrub/Mixed Conifer	Immature	High	
181	Shrub/Mixed Conifer	Mature	Low	
182	Shrub/Mixed Conifer	Mature	Medium	
183	Shrub/Mixed Conifer	Mature	High	
184	Ponderosa Pine	Mature	Low(-)	
185	Ponderosa Pine	Overmature	Low(-)	
186	Mixed Conifer	Mature	Low(-)	
187	Mixed Conifer	Overmature	Low(-)	
188	Lodgepole Pine	Immature	Low(-)	

Acronyms and Abbreviations:
L&S = Lop and scatter
YUM = Yard unmerchantable material
TA = Leave tops attached
NMT = No mechanical treatment
PCT = Precommercial thinning
CT = Commercial thinning

Table B-2
Fuel Loading Characteristics for Fuel Condition Classes in FETM

					Fuel Loading												Duff	Fuel	Height to Base
	Vegetation	Age	Loading	Activity	Shrub	Herb	Total	1-hr	10-hr	100-hr	1000	10000	10000+	Total	Duff	Total	Depth	Depth	of Ladder Fuels
FCC	Type	Class	Class	Class	(t/ac)	(t/ac)	(t/ac)	(t/ac)	(t/ac)	(t/ac)	(t/ac)	(t/ac)	(t/ac)	(t/ac)	(t/ac)	(t/ac)	(inches)	(feet)	(feet)
1	PP	Bare	Low		0.4	0.3	0.7	0.5	0.8	1.7	1.9	3.0	0.0	7.9	2.3	10.9	0.3	0.25	-
2	PP	Bare	Medium		0.5	0.5	1.0	0.5	1.9	5.1	3.4	4.1	0.0	15.0	2.3	18.3	0.3	0.40	-
3	PP	Bare	High		0.4	0.5	0.9	0.5	0.4	2.3	2.7	4.2	8.4	18.5	2.3	21.7	0.3	0.40	-
4	PP	Immature	Low		0.5	0.5	1.0	0.1	1.5	2.2	1.1	1.8	3.3	10.0	6.0	17.0	0.8	0.50	12
5	PP	Immature	Medium		0.5	0.8	1.3	0.1	1.5	4.8	5.5	2.3	3.3	17.5	6.0	24.8	0.8	1.00	12
6	PP	Immature	High		0.7	1.1	1.8	0.1	3.9	4.5	9.5	3.0	3.3	24.3	6.0	32.1	0.8	1.00	12
7	PP	Mature	Low		0.4	0.8	1.2	0.1	0.6	1.6	0.4	1.0	5.6	9.3	9.8	20.3	1.3	0.25	23
8	PP	Mature	Medium		0.0	0.0	0.0	0.1	1.6	4.2	2.1	2.9	4.7	15.6	9.8	25.4	1.3	0.50	23
9	PP	Mature	High		0.4	0.3	0.7	0.1	1.1	2.5	10.3	6.0	3.6	23.6	9.8	34.1	1.3	0.50	23
10	PP	Overmature	Low		2.5	0.5	3.0	0.2	1.2	2.3	2.3	2.4	2.0	10.4	12.8	26.2	1.7	0.50	27
11	PP	Overmature	Medium		0.5	0.5	1.0	0.0	1.5	4.9	10.1	6.2	4.0	26.7	12.8	40.6	1.7	1.00	27
12	PP	Overmature	High		0.4	0.3	0.7	0.0	0.3	1.5	6.7	22.8	9.0	40.3	12.8	53.9	1.7	1.00	27
13	PP	Immature	Low	PCT/Pile	0.0	0.0	0.0	0.5	3.4	2.3	1.9	0.0	0.0	8.1	8.3	16.4	1.1	0.50	12
14	PP	Immature	Low	PCT/L&S or Crush	0.0	0.0	0.0	0.5	3.4	2.3	1.9	0.0	0.0	8.1	8.3	16.4	1.1	0.30	12
15	PP	Immature	Low	PCT or CT/NMT	0.0	0.0	0.0	0.5	3.4	2.3	1.9	0.0	0.0	8.1	8.3	16.4	1.1	0.50	12
16	PP	Immature	Low	CT/Pile	0.0	0.0	0.0	0.5	2.7	5.5	1.0	0.0	0.0	9.7	8.3	18.0	1.1	0.50	12
17	PP	Immature	Low	CT/L&S or Crush	0.0	0.0	0.0	0.5	2.7	5.5	1.0	0.0	0.0	9.7	8.3	18.0	1.1	0.30	12
18	PP	Immature	Medium	PCT/Pile	0.0	0.0	0.0	0.5	5.2	7.0	3.9	0.0	0.0	16.6	8.3	24.9	1.1	1.20	12
19	PP	Immature	Medium	PCT/L&S or Crush	0.0	0.0	0.0	0.5	5.2	7.0	3.9	0.0	0.0	16.6	8.3	24.9	1.1	0.75	12
20	PP	Immature	Medium	CT/L&S or Crush	0.0	0.0	0.0	0.5	5.2	7.0	3.9	0.0	0.0	16.6	8.3	24.9	1.1	1.20	12
21	PP	Immature	Medium	CT/Pile	0.0	0.0	0.0	0.5	5.2	7.0	3.9	0.0	0.0	16.6	8.3	24.9	1.1	1.20	12
22	PP	Immature	Medium	CT/L&S or Crush	0.0	0.0	0.0	0.5	5.2	7.0	3.9	0.0	0.0	16.6	8.3	24.9	1.1	0.75	12
23	PP	Immature	High	PCT/Pile	0.0	0.0	0.0	0.5	5.5	6.7	12.8	0.0	3.5	29.0	8.3	37.3	1.1	1.80	12
24	PP	Immature	High	PCT/L&S or Crush	0.0	0.0	0.0	0.5	5.5	6.7	12.8	0.0	3.5	29.0	8.3	37.3	1.1	1.00	12
25	PP	Immature	High	CT/L&S or Crush	0.0	0.0	0.0	0.5	5.5	6.7	12.8	0.0	3.5	29.0	8.3	37.3	1.1	1.80	12
26	PP	Immature	High	CT/Pile	0.0	0.0	0.0	0.5	5.5	6.7	3.9	0.0	3.5	20.1	8.3	28.4	1.1	1.00	12
27	PP	Immature	High	CT/L&S or Crush	0.0	0.0	0.0	0.5	5.5	6.7	3.9	0.0	3.5	20.1	8.3	28.4	1.1	0.75	12
28	PP	Mature	Low	Logged	0.0	0.0	0.0	0.5	2.7	5.0	5.7	0.0	0.0	13.9	6.0	19.9	0.8	0.30	33
29	PP	Mature	Low	Logged	0.0	0.0	0.0	0.5	2.7	5.0	5.7	0.0	0.0	13.9	6.0	19.9	0.8	0.30	33
30	PP	Mature	Low	Logged/Crush	0.0	0.0	0.0	0.5	2.7	5.0	5.7	0.0	0.0	13.9	6.0	19.9	0.8	0.20	33
31	PP	Mature	Low	Logged/YUM	0.0	0.0	0.0	0.5	2.2	3.4	2.9	0.0	0.0	9.0	6.0	15.0	0.8	0.30	33
32	PP	Mature	Medium	Logged	0.0	0.0	0.0	0.5	2.3	4.8	4.3	6.2	0.0	18.1	6.0	24.1	0.8	0.50	33
33	PP	Mature	Medium	Logged	0.0	0.0	0.0	0.5	2.3	4.8	4.3	6.2	0.0	18.1	6.0	24.1	0.8	0.50	33
34	PP	Mature	Medium	Logged/Crush	0.0	0.0	0.0	0.5	2.3	4.8	4.3	6.2	0.0	18.1	6.0	24.1	0.8	0.40	33
35	PP	Mature	Medium	Logged/YUM	0.0	0.0	0.0	0.5	2.7	5.0	3.7	1.0	1.0	13.9	6.0	19.9	0.8	0.50	33
36	PP	Mature	High	Logged	0.0	0.0	0.0	0.5	3.8	7.4	7.1	4.6	6.6	30.0	6.0	36.0	0.8	0.50	33
37	PP	Mature	High	Logged	0.0	0.0	0.0	0.5	3.8	7.4	7.1	4.6	6.6	30.0	6.0	36.0	0.8	0.50	33
38	PP	Mature	High	Logged/Crush	0.0	0.0	0.0	0.5	3.8	7.4	7.1	4.6	6.6	30.0	6.0	36.0	0.8	0.40	33
39	PP	Mature	High	Logged/YUM	0.0	0.0	0.0	0.5	2.3	4.8	4.3	8.2	2.5	22.6	6.0	28.6	0.8	0.50	33
40	PP	Overmature	Low	Logged	0.0	0.0	0.0	0.5	2.7	5.0	5.7	2.0	2.0	17.9	6.0	23.9	0.8	0.30	39
41	PP	Overmature	Low	Logged	0.0	0.0	0.0	0.5	2.7	5.0	5.7	2.0	2.0	17.9	6.0	23.9	0.8	0.30	39
42	PP	Overmature	Low	Logged/Crush	0.0	0.0	0.0	0.5	2.7	5.0	5.7	2.0	2.0	17.9	6.0	23.9	0.8	0.20	39
43	PP	Overmature	Low	Logged/YUM	0.0	0.0	0.0	0.5	2.7	5.0	5.7	0.0	0.0	13.9	6.0	19.9	0.8	0.30	39

Table B-2
Fuel Loading Characteristics for Fuel Condition Classes in FETM

					Fuel Loading												Duff	Fuel	Height to Base
	Vegetation	Age	Loading	Activity	Shrub	Herb	Total	1-hr	10-hr	100-hr	1000	10000	10000+	Total	Duff	Total	Depth	Depth	of Ladder Fuels
FCC	Type	Class	Class	Class	(t/ac)	(t/ac)	(t/ac)	(t/ac)	(t/ac)	(t/ac)	(t/ac)	(t/ac)	(t/ac)	(t/ac)	(t/ac)	(t/ac)	(inches)	(feet)	(feet)
44	PP	Overmature	Medium	Logged	0.0	0.0	0.0	0.5	2.4	5.1	10.2	8.6	3.0	29.8	6.0	35.8	0.8	0.50	39
45	PP	Overmature	Medium	Logged	0.0	0.0	0.0	0.5	2.4	5.1	10.2	8.6	3.0	29.8	6.0	35.8	0.8	0.50	39
46	PP	Overmature	Medium	Logged/Crush	0.0	0.0	0.0	0.5	2.4	5.1	10.2	8.6	3.0	29.8	6.0	35.8	0.8	0.40	39
47	PP	Overmature	Medium	Logged/YUM	0.0	0.0	0.0	0.5	2.3	4.8	4.3	8.2	2.5	22.6	6.0	28.6	0.8	0.50	39
48	PP	Overmature	High	Logged	0.0	0.0	0.0	0.5	2.4	5.1	14.0	11.0	5.0	38.0	6.0	44.0	0.8	1.00	39
49	PP	Overmature	High	Logged	0.0	0.0	0.0	0.5	2.4	5.1	14.0	11.0	5.0	38.0	6.0	44.0	0.8	1.00	39
50	PP	Overmature	High	Logged/Crush	0.0	0.0	0.0	0.5	2.4	5.1	14.0	11.0	5.0	38.0	6.0	44.0	0.8	0.70	39
51	PP	Overmature	High	Logged/YUM	0.0	0.0	0.0	0.5	3.9	4.8	10.0	5.5	6.9	31.6	6.0	37.6	0.8	1.00	39
52	MC	Bare	Low		0.5	0.5	1.0	0.6	2.3	1.9	2.0	0.0	0.0	6.8	2.3	10.1	0.3	0.30	-
53	MC	Bare	Medium		0.5	0.5	1.0	0.5	1.3	3.0	4.5	1.5	0.0	10.8	2.3	14.1	0.3	0.70	-
54	MC	Bare	High		0.4	0.3	0.7	0.4	0.6	1.1	8.8	7.2	0.0	18.1	2.3	21.1	0.3	0.40	-
55	MC	Immature	Low		0.5	0.5	1.0	0.6	2.3	1.9	2.0	0.0	0.0	6.8	9.1	16.9	1.2	0.30	14
56	MC	Immature	Medium		0.5	0.5	1.0	0.5	1.3	3.0	4.5	1.5	0.0	10.8	9.1	20.9	1.2	0.70	14
57	MC	Immature	High		0.4	0.3	0.7	0.4	0.6	1.1	8.8	7.2	0.0	18.1	9.1	27.9	1.2	0.40	14
58	MC	Mature	Low		0.4	0.3	0.7	0.7	1.1	1.5	3.1	4.7	0.0	11.1	15.9	27.7	2.1	0.20	20
59	MC	Mature	Medium		0.7	0.7	1.4	0.5	1.8	3.5	12.3	2.3	0.0	20.4	15.9	37.7	2.1	0.20	20
60	MC	Mature	High		0.5	0.5	1.0	0.7	1.6	1.9	13.9	13.7	0.0	31.8	15.9	48.7	2.1	0.30	20
61	MC	Overmature	Low		0.4	0.3	0.7	0.5	1.2	1.2	2.5	5.2	2.0	12.6	20.4	33.7	2.7	0.30	40
62	MC	Overmature	Medium		0.5	0.8	1.3	0.5	2.6	4.3	7.0	10.5	3.0	27.9	20.4	49.6	2.7	0.30	40
63	MC	Overmature	High		0.5	0.5	1.0	1.2	3.0	4.1	14.9	16.5	5.0	44.7	20.4	66.1	2.7	0.80	40
64	MC	Immature	Low	PCT/Pile	0.0	0.0	0.0	0.5	2.7	5.5	2.3	0.0	0.0	11.0	8.3	19.3	1.1	0.70	14
65	MC	Immature	Low	PCT/L&S or Crush	0.0	0.0	0.0	0.5	2.7	5.5	2.3	0.0	0.0	11.0	8.3	19.3	1.1	0.50	14
66	MC	Immature	Low	CT/L&S or Crush	0.0	0.0	0.0	0.5	2.7	5.5	2.3	0.0	0.0	11.0	8.3	19.3	1.1	0.70	14
67	MC	Immature	Low	CT/Pile	0.0	0.0	0.0	0.5	2.7	5.5	2.3	0.0	0.0	11.0	8.3	19.3	1.1	0.70	14
68	MC	Immature	Low	CT/L&S or Crush	0.0	0.0	0.0	0.5	2.7	5.5	2.3	0.0	0.0	11.0	8.3	19.3	1.1	0.50	14
69	MC	Immature	Medium	PCT/Pile	0.0	0.0	0.0	0.5	5.2	13.0	3.9	0.0	0.0	22.6	8.3	30.9	1.1	0.80	14
70	MC	Immature	Medium	PCT/L&S or Crush	0.0	0.0	0.0	0.5	5.2	13.0	3.9	0.0	0.0	22.6	8.3	30.9	1.1	0.50	14
71	MC	Immature	Medium	CT/L&S or Crush	0.0	0.0	0.0	0.5	5.2	13.0	3.9	0.0	0.0	22.6	8.3	30.9	1.1	0.80	14
72	MC	Immature	Medium	CT/Pile	0.0	0.0	0.0	0.5	2.7	5.0	5.7	0.0	0.0	13.9	8.3	22.2	1.1	0.50	14
73	MC	Immature	Medium	CT/L&S or Crush	0.0	0.0	0.0	0.5	2.7	5.0	5.7	0.0	0.0	13.9	8.3	22.2	1.1	0.30	14
74	MC	Immature	High	PCT/Pile	0.0	0.0	0.0	0.5	5.5	13.7	8.8	0.0	3.5	32.0	8.3	40.3	1.1	1.80	14
75	MC	Immature	High	PCT/L&S or Crush	0.0	0.0	0.0	0.5	5.5	13.7	8.8	0.0	3.5	32.0	8.3	40.3	1.1	1.00	14
76	MC	Immature	High	CT/L&S or Crush	0.0	0.0	0.0	0.5	5.5	13.7	8.8	0.0	3.5	32.0	8.3	40.3	1.1	1.80	14
77	MC	Immature	High	CT/Pile	0.0	0.0	0.0	0.5	5.2	13.0	3.9	0.0	0.0	22.6	8.3	30.9	1.1	0.80	14
78	MC	Immature	High	CT/L&S or Crush	0.0	0.0	0.0	0.5	5.2	13.0	3.9	0.0	0.0	22.6	8.3	30.9	1.1	0.60	14
79	MC	Mature	Low	Logged	0.0	0.0	0.0	0.5	2.7	5.0	5.7	3.0	1.0	17.9	15.1	33.0	2.0	0.30	36
80	MC	Mature	Low	Logged	0.0	0.0	0.0	0.5	2.7	5.0	5.7	3.0	1.0	17.9	15.1	33.0	2.0	0.30	36
81	MC	Mature	Low	Logged/Crush	0.0	0.0	0.0	0.5	2.7	5.0	5.7	3.0	1.0	17.9	15.1	33.0	2.0	0.20	36
82	MC	Mature	Low	Logged/YUM	0.0	0.0	0.0	0.5	2.7	5.0	2.0	0.0	0.0	10.2	15.1	25.3	2.0	0.30	36
83	MC	Mature	Medium	Logged	0.0	0.0	0.0	0.5	3.2	4.8	12.3	5.4	1.0	27.2	15.1	42.3	2.0	0.60	36
84	MC	Mature	Medium	Logged	0.0	0.0	0.0	0.5	3.2	4.8	12.3	5.4	1.0	27.2	15.1	42.3	2.0	0.60	36
85	MC	Mature	Medium	Logged/Crush	0.0	0.0	0.0	0.5	3.2	4.8	12.3	5.4	1.0	27.2	15.1	42.3	2.0	0.40	36
86	MC	Mature	MED	Logged/YUM	0.0	0.0	0.0	0.5	2.3	4.8	3.3	3.2	2.5	16.6	15.1	31.7	2.0	1.00	36
87	MC	Mature	High	Logged	0.0	0.0	0.0	0.5	2.1	6.3	10.3	10.8	11.6	41.6	15.1	56.7	2.0	1.00	36

Table B-2
Fuel Loading Characteristics for Fuel Condition Classes in FETM

					Fuel Loading												Duff	Fuel	Height to Base
	Vegetation	Age	Loading	Activity	Shrub	Herb	Total	1-hr	10-hr	100-hr	1000	10000	10000+	Total	Duff	Total	Depth	Depth	of Ladder Fuels
FCC	Type	Class	Class	Class	(t/ac)	(t/ac)	(t/ac)	(t/ac)	(t/ac)	(t/ac)	(t/ac)	(t/ac)	(t/ac)	(t/ac)	(t/ac)	(t/ac)	(inches)	(feet)	(feet)
88	MC	Mature	High	Logged	0.0	0.0	0.0	0.5	2.1	6.3	10.3	10.8	11.6	41.6	15.1	56.7	2.0	1.00	36
89	MC	Mature	High	Logged/Crush	0.0	0.0	0.0	0.5	2.1	6.3	10.3	10.8	11.6	41.6	15.1	56.7	2.0	0.70	36
90	MC	Mature	High	Logged/YUM	0.0	0.0	0.0	0.5	2.1	6.3	4.3	5.8	7.6	26.6	15.1	41.7	2.0	0.60	36
91	MC	Overmature	Low	Logged	0.0	0.0	0.0	0.5	2.3	4.8	4.3	8.2	2.5	22.6	15.1	37.7	2.0	0.30	58
92	MC	Overmature	Low	Logged	0.0	0.0	0.0	0.5	2.3	4.8	4.3	8.2	2.5	22.6	15.1	37.7	2.0	0.30	58
93	MC	Overmature	Low	Logged/Crush	0.0	0.0	0.0	0.5	2.3	4.8	4.3	8.2	2.5	22.6	15.1	37.7	2.0	0.20	58
94	MC	Overmature	Low	Logged/YUM	0.0	0.0	0.0	0.5	2.3	4.8	2.3	4.2	1.5	15.6	15.1	30.7	2.0	0.30	58
95	MC	Overmature	Medium	Logged	0.0	0.0	0.0	0.5	3.9	4.8	10.0	5.5	6.9	31.6	15.1	46.7	2.0	0.70	58
96	MC	Overmature	Medium	Logged	0.0	0.0	0.0	0.5	3.9	4.8	10.0	5.5	6.9	31.6	15.1	46.7	2.0	0.70	58
97	MC	Overmature	Medium	Logged/Crush	0.0	0.0	0.0	0.5	3.9	4.8	10.0	5.5	6.9	31.6	15.1	46.7	2.0	0.50	58
98	MC	Overmature	Medium	Logged/YUM	0.0	0.0	0.0	0.5	3.9	4.8	5.0	3.5	4.9	22.6	15.1	37.7	2.0	0.50	58
99	MC	Overmature	High	Logged	0.0	0.0	0.0	0.5	2.1	6.3	10.3	10.8	11.6	41.6	15.1	56.7	2.0	1.00	58
100	MC	Overmature	High	Logged	0.0	0.0	0.0	0.5	2.1	6.3	10.3	10.8	11.6	41.6	15.1	56.7	2.0	1.00	58
101	MC	Overmature	High	Logged/Crush	0.0	0.0	0.0	0.5	2.1	6.3	10.3	10.8	11.6	41.6	15.1	56.7	2.0	0.70	58
102	MC	Overmature	High	Logged/YUM	0.0	0.0	0.0	0.5	2.1	6.3	5.3	5.8	10.0	30.0	15.1	45.1	2.0	0.70	58
103	LP	Bare	Low		0.4	0.3	0.7	0.5	0.8	1.7	0.9	0.0	0.0	3.9	2.3	6.9	0.3	0.10	-
104	LP	Bare	Medium		0.4	0.3	0.7	0.5	1.9	3.1	3.4	2.1	0.0	11.0	2.3	14.0	0.3	0.20	-
105	LP	Bare	High		0.7	0.7	1.4	0.5	1.9	5.1	3.4	4.1	0.0	15.0	2.3	18.7	0.3	0.20	-
106	LP	Immature	Low		0.5	0.5	1.0	0.3	0.7	4.0	0.8	0.0	0.0	5.8	3.8	10.6	0.5	0.20	30
107	LP	Immature	Medium		0.5	0.5	1.0	0.4	1.2	7.4	2.1	0.0	0.0	11.1	3.8	15.9	0.5	0.40	30
108	LP	Immature	High		0.7	0.7	1.4	0.6	2.1	10.4	4.7	0.0	0.0	17.8	3.8	23.0	0.5	0.80	30
109	LP	Mature	Low		0.5	0.5	1.0	0.3	0.7	4.0	0.8	0.0	0.0	5.8	4.5	11.3	0.6	0.20	46
110	LP	Mature	Medium		0.5	0.5	1.0	0.7	2.3	5.9	5.1	2.0	0.0	16.0	4.5	21.5	0.6	0.30	46
111	LP	Mature	High		0.0	0.0	0.0	0.5	1.9	7.0	9.6	16.1	0.0	35.1	4.5	39.6	0.6	0.30	46
112	LP	Overmature	Low		0.4	0.3	0.7	0.2	0.9	1.7	1.3	3.0	0.0	7.1	6.0	13.8	0.8	0.10	36
113	LP	Overmature	Medium		0.5	0.5	1.0	0.2	1.1	3.4	14.8	3.5	0.0	23.0	6.0	30.0	0.8	0.30	36
114	LP	Overmature	High		0.5	0.5	1.0	0.5	1.9	7.0	14.6	16.1	0.0	40.1	6.0	47.1	0.8	0.50	36
115	LP	Immature	Low	PCT/Pile	0.0	0.0	0.0	0.5	2.4	2.3	1.9	0.0	0.0	7.1	9.8	16.9	1.3	0.40	30
116	LP	Immature	Low	PCT/L&S or Crush	0.0	0.0	0.0	0.5	2.4	2.3	1.9	0.0	0.0	7.1	9.8	16.9	1.3	0.30	30
117	LP	Immature	Low	CT/L&S or Crush	0.0	0.0	0.0	0.5	2.4	2.3	1.9	0.0	0.0	7.1	9.8	16.9	1.3	0.40	30
118	LP	Immature	Low	CT/Pile	0.0	0.0	0.0	0.5	3.4	2.3	1.9	0.0	0.0	8.1	9.8	17.9	1.3	0.50	30
119	LP	Immature	Low	CT/L&S or Crush	0.0	0.0	0.0	0.5	3.4	2.3	1.9	0.0	0.0	8.1	9.8	17.9	1.3	0.30	30
120	LP	Immature	Medium	PCT/Pile	0.0	0.0	0.0	0.5	2.1	7.0	5.3	0.0	0.0	14.9	9.8	24.7	1.3	1.00	30
121	LP	Immature	Medium	PCT/L&S or Crush	0.0	0.0	0.0	0.5	2.1	7.0	5.3	0.0	0.0	14.9	9.8	24.7	1.3	0.60	30
122	LP	Immature	Medium	CT/L&S or Crush	0.0	0.0	0.0	0.5	2.1	7.0	5.3	0.0	0.0	14.9	9.8	24.7	1.3	0.60	30
123	LP	Immature	Medium	CT/Pile	0.0	0.0	0.0	0.5	3.5	3.2	5.4	0.0	0.0	12.6	9.8	22.4	1.3	0.30	30
124	LP	Immature	Medium	CT/L&S or Crush	0.0	0.0	0.0	0.5	3.5	3.2	5.4	0.0	0.0	12.6	9.8	22.4	1.3	0.20	30
125	LP	Immature	High	PCT/Pile	0.0	0.0	0.0	0.5	5.5	6.7	12.8	0.0	3.5	29.0	9.8	38.8	1.3	1.50	30
126	LP	Immature	High	PCT/L&S or Crush	0.0	0.0	0.0	0.5	5.5	6.7	12.8	0.0	3.5	29.0	9.8	38.8	1.3	1.00	30
127	LP	Immature	High	CT/L&S or Crush	0.0	0.0	0.0	0.5	5.5	6.7	12.8	0.0	3.5	29.0	9.8	38.8	1.3	1.50	30
128	LP	Immature	High	CT/Pile	0.0	0.0	0.0	0.5	5.2	13.0	3.9	0.0	0.0	22.6	9.8	32.4	1.3	0.80	30
129	LP	Immature	High	CT/L&S or Crush	0.0	0.0	0.0	0.5	5.2	13.0	3.9	0.0	0.0	22.6	9.8	32.4	1.3	0.50	30
130	LP	Mature	Low	Logged	0.0	0.0	0.0	0.5	1.3	5.5	3.0	0.0	0.0	10.3	5.3	15.6	0.7	0.20	54
131	LP	Mature	Low	Logged	0.0	0.0	0.0	0.5	1.3	5.5	3.0	0.0	0.0	10.3	5.3	15.6	0.7	0.20	54

Table B-2
Fuel Loading Characteristics for Fuel Condition Classes in FETM

					Fuel Loading												Duff	Fuel	Height to Base
	Vegetation	Age	Loading	Activity	Shrub	Herb	Total	1-hr	10-hr	100-hr	1000	10000	10000+	Total	Duff	Total	Depth	Depth	of Ladder Fuels
FCC	Type	Class	Class	Class	(t/ac)	(t/ac)	(t/ac)	(t/ac)	(t/ac)	(t/ac)	(t/ac)	(t/ac)	(t/ac)	(t/ac)	(t/ac)	(t/ac)	(inches)	(feet)	(feet)
132	LP	Mature	Low	Logged/Crush	0.5	0.5	1.0	0.5	1.3	5.5	3.0	0.0	0.0	10.3	5.3	16.6	0.7	0.10	54
133	LP	Mature	Low	Logged/YUM	0.0	0.0	0.0	0.5	1.3	4.5	1.5	0.0	0.0	7.8	5.3	13.1	0.7	0.10	54
134	LP	Mature	Medium	Logged	0.0	0.0	0.0	0.5	1.7	4.1	6.5	5.2	0.0	18.0	5.3	23.3	0.7	0.30	54
135	LP	Mature	Medium	Logged	0.0	0.0	0.0	0.5	1.7	4.1	6.5	5.2	0.0	18.0	5.3	23.3	0.7	0.30	54
136	LP	Mature	Medium	Logged/Crush	0.0	0.0	0.0	0.5	1.7	4.1	6.5	5.2	0.0	18.0	5.3	23.3	0.7	0.20	54
137	LP	Mature	Medium	Logged/YUM	0.0	0.0	0.0	0.5	1.7	4.1	3.5	3.2	0.0	13.0	5.3	18.3	0.7	0.20	54
138	LP	Mature	High	Logged	0.0	0.0	0.0	0.5	2.5	6.6	15.8	1.2	0.0	26.6	5.3	31.9	0.7	0.50	54
139	LP	Mature	High	Logged	0.0	0.0	0.0	0.5	2.5	6.6	15.8	1.2	0.0	26.6	5.3	31.9	0.7	0.50	54
140	LP	Mature	High	Logged/Crush	0.0	0.0	0.0	0.5	2.5	6.6	15.8	1.2	0.0	26.6	5.3	31.9	0.7	0.30	54
141	LP	Mature	High	Logged/YUM	0.0	0.0	0.0	0.5	2.5	6.6	7.8	1.2	0.0	18.6	5.3	23.9	0.7	0.30	54
142	LP	Overmature	Low	Logged	0.0	0.0	0.0	0.5	2.2	3.4	2.9	0.0	0.0	9.0	5.3	14.3	0.7	0.20	45
143	LP	Overmature	Low	Logged	0.0	0.0	0.0	0.5	2.2	3.4	2.9	0.0	0.0	9.0	5.3	14.3	0.7	0.20	45
144	LP	Overmature	Low	Logged/Crush	0.0	0.0	0.0	0.5	2.2	3.4	2.9	0.0	0.0	9.0	5.3	14.3	0.7	0.10	45
145	LP	Overmature	Low	Logged/YUM	0.0	0.0	0.0	0.5	2.2	2.4	1.5	0.0	0.0	6.6	5.3	11.9	0.7	0.10	45
146	LP	Overmature	Medium	Logged	0.0	0.0	0.0	0.5	1.7	4.1	6.5	5.2	0.0	18.0	5.3	23.3	0.7	0.30	45
147	LP	Overmature	Medium	Logged	0.0	0.0	0.0	0.5	1.7	4.1	6.5	5.2	0.0	18.0	5.3	23.3	0.7	0.30	45
148	LP	Overmature	Medium	Logged/Crush	0.0	0.0	0.0	0.5	1.7	4.1	6.5	5.2	0.0	18.0	5.3	23.3	0.7	0.20	45
149	LP	Overmature	Medium	Logged/YUM	0.0	0.0	0.0	0.5	1.7	4.1	3.5	3.2	0.0	13.0	5.3	18.3	0.7	0.20	45
150	LP	Overmature	High	Logged	0.0	0.0	0.0	0.5	2.5	6.6	15.8	1.2	0.0	26.6	5.3	31.9	0.7	0.50	45
151	LP	Overmature	High	Logged	0.0	0.0	0.0	0.5	2.5	6.6	15.8	1.2	0.0	26.6	5.3	31.9	0.7	0.50	45
152	LP	Overmature	High	Logged/Crush	0.0	0.0	0.0	0.5	2.5	6.6	15.8	1.2	0.0	26.6	5.3	31.9	0.7	0.30	45
153	LP	Overmature	High	Logged/YUM	0.0	0.0	0.0	0.5	2.5	6.6	7.8	1.2	0.0	18.6	5.3	23.9	0.7	0.30	45
154	WJ	Bare	Low		2.5	0.5	3.0	0.2	0.4	0.3	0.0	0.0	0.0	0.9	1.5	5.4	0.2	1.00	-
155	WJ	Bare	Medium		2.5	0.5	3.0	0.2	0.4	0.3	0.0	0.0	0.0	0.9	1.5	5.4	0.2	1.00	-
156	WJ	Bare	High		2.5	0.5	3.0	0.2	0.4	0.3	0.0	0.0	0.0	0.9	1.5	5.4	0.2	1.00	-
157	WJ	Immature	Low		2.5	0.5	3.0	0.2	0.4	0.3	0.0	0.0	0.0	0.9	1.5	5.4	0.2	1.00	0
158	WJ	Immature	Medium		2.5	0.5	3.0	0.2	0.4	0.3	0.0	0.0	0.0	0.9	1.5	5.4	0.2	1.00	0
159	WJ	Immature	High		2.5	0.5	3.0	0.2	0.4	0.3	0.0	0.0	0.0	0.9	1.5	5.4	0.2	1.00	0
160	WJ	Mature	Low		3.3	0.7	4.0	0.2	0.4	0.8	0.0	0.0	0.0	1.4	2.3	7.7	0.3	1.00	1
161	WJ	Mature	Medium		3.3	0.7	4.0	0.2	0.4	0.8	0.0	0.0	0.0	1.4	2.3	7.7	0.3	1.00	1
162	WJ	Mature	High		3.3	0.7	4.0	0.2	0.4	0.8	0.0	0.0	0.0	1.4	2.3	7.7	0.3	1.00	1
163	G	Mature	Low		0.0	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	1.0	0.1	0.80	-
164	G/PP	Mature	Low		0.0	0.2	0.2	0.0	0.2	0.5	0.1	0.0	0.0	0.8	7.6	8.6	1.0	0.40	23
165	G/LP	Mature	Low		0.7	0.7	1.4	0.4	1.1	0.7	0.8	0.0	0.0	3.0	4.5	8.9	0.6	0.40	46
166	G	Mature	Medium		0.0	0.3	0.3	0.0	0.2	0.0	0.0	0.0	0.0	0.2	0.8	1.3	0.1	0.80	-
167	G/PP	Mature	Medium		0.4	0.3	0.7	0.1	1.5	1.2	0.8	1.7	0.0	5.3	7.6	13.6	1.0	2.00	23
168	G/LP	Mature	Medium		0.4	0.5	0.9	0.2	0.9	1.7	1.3	0.0	0.0	4.1	4.5	9.5	0.6	2.00	46
169	G	Mature	High		0.0	0.3	0.3	0.0	0.2	0.0	0.0	0.0	0.0	0.2	0.8	1.3	0.1	0.80	-
170	G/PP	Mature	High		0.0	0.3	0.3	0.1	1.0	2.5	2.3	3.4	4.5	13.8	7.6	21.7	1.0	2.00	23
171	G/LP	Mature	High		0.5	0.5	1.0	0.2	1.0	4.1	10.7	0.8	0.0	16.8	4.5	22.3	0.6	2.00	46
172	S	Immature	Low		9.0	0.0	9.0	0.1	0.7	0.8	1.7	0.0	0.0	3.3	1.5	13.8	0.2	0.25	-
173	S	Immature	Medium		9.0	0.0	9.0	0.1	0.7	0.8	1.7	2.0	0.0	5.3	1.5	15.8	0.2	0.25	-
174	S	Immature	High		9.0	0.0	9.0	0.3	0.8	0.8	0.5	3.6	0.0	6.0	1.5	16.5	0.2	0.25	-
175	S	Mature	Low		9.0	0.0	9.0	0.3	0.8	0.8	0.5	3.6	0.0	6.0	1.5	16.5	0.2	1.25	-

Table B-2
Fuel Loading Characteristics for Fuel Condition Classes in FETM

					Fuel Loading												Duff	Fuel	Height to Base
	Vegetation	Age	Loading	Activity	Shrub	Herb	Total	1-hr	10-hr	100-hr	1000	10000	10000+	Total	Duff	Total	Depth	Depth	of Ladder Fuels
FCC	Type	Class	Class	Class	(t/ac)	(t/ac)	(t/ac)	(t/ac)	(t/ac)	(t/ac)	(t/ac)	(t/ac)	(t/ac)	(t/ac)	(t/ac)	(t/ac)	(inches)	(feet)	(feet)
176	S	Mature	Medium		9.0	0.0	9.0	0.2	1.1	1.0	0.5	4.8	0.0	7.6	1.5	18.1	0.2	1.35	-
177	S	Mature	High		9.0	0.0	9.0	0.2	1.2	2.3	2.3	2.4	0.0	8.0	1.5	18.5	0.2	1.25	-
178	S/MC	Immature	Low		1.8	0.3	2.1	0.6	2.3	1.9	2.0	0.0	0.0	6.8	13.6	22.5	1.8	1.25	14
179	S/MC	Immature	Medium		2.5	0.5	3.0	0.5	1.3	3.0	4.5	0.0	0.0	9.3	10.6	22.9	1.4	1.25	14
180	S/MC	Immature	High		3.3	0.7	4.0	1.3	3.4	4.9	4.5	0.0	0.0	14.1	15.1	33.2	2.0	1.25	14
181	S/MC	Mature	Low		1.8	0.3	2.1	0.7	1.1	1.5	3.1	4.7	0.0	11.1	13.6	26.8	1.8	1.25	20
182	S/MC	Mature	Medium		2.5	0.5	3.0	0.5	1.8	3.5	12.3	2.3	0.0	20.4	10.6	34.0	1.4	1.25	20
183	S/MC	Mature	High		3.3	0.7	4.0	0.8	2.7	2.6	10.6	13.3	0.0	30.0	15.1	49.1	2.0	1.25	20
184	PP	Mature	Low-		2.5	0.5	3.0	0.1	0.4	0.7	0.4	1.0	1.0	3.6	9.8	16.4	1.3	0.10	23
185	PP	Overmature	Low-		0.4	0.5	0.9	0.5	0.4	1.8	0.5	1.0	1.0	5.2	5.3	11.4	0.7	0.25	27
186	MC	Mature	Low-		0.4	0.3	0.7	0.6	1.3	1.4	2.0	0.0	0.0	5.3	15.9	21.9	2.1	0.20	20
187	MC	Overmature	Low-		0.4	0.3	0.7	0.1	0.7	0.8	1.7	2.0	1.0	6.3	20.4	27.4	2.7	0.20	40
188	LP	Immature	Low-		0.4	0.3	0.7	0.3	0.4	2.0	0.4	0.0	0.0	3.1	3.8	7.6	0.5	0:10	30

Table B-3 Spread Components Used in FETM[1]							
	Vegetation	Age	Loading	Activity	Spread Component (feet/minute)		
FCC	Type	Class	Class	Class	Extreme	V. High	High
1	PP	Bare	Low		4.0	3.0	1.0
2	PP	Bare	Medium		4.0	3.0	1.0
3	PP	Bare	High		4.0	3.0	1.0
4	PP	Immature	Low		4.5	3.0	1.7
5	PP	Immature	Medium		9.8	6.0	3.4
6	PP	Immature	High		12.8	7.5	5.1
7	PP	Mature	Low		3.0	2.3	1.7
8	PP	Mature	Medium		4.5	3.0	1.7
9	PP	Mature	High		2.3	1.5	0.9
10	PP	Overmature	Low		13.5	8.3	4.3
11	PP	Overmature	Medium		2.3	1.5	0.9
12	PP	Overmature	High		3.0	2.3	1.7
13	PP	Immature	Low	PCT/Pile	1.0	1.0	1.0
14	PP	Immature	Low	PCT/L&S	2.3	1.5	0.9
15	PP	Immature	Low	PCT or CT/NMT	4.5	2.3	1.7
16	PP	Immature	Low	CT/Pile	1.0	1.0	1.0
17	PP	Immature	Low	CT/L&S	2.3	1.5	0.9
18	PP	Immature	Medium	PCT/Pile	1.0	1.0	1.0
19	PP	Immature	Medium	PCT/L&S	6.0	3.8	2.6
20	PP	Immature	Medium	PCT or CT/NMT	9.8	6.8	5.1
21	PP	Immature	Medium	CT/Pile	1.0	1.0	1.0
22	PP	Immature	Medium	CT/L&S	6.0	3.8	2.6
23	PP	Immature	High	PCT/Pile	1.0	1.0	1.0
24	PP	Immature	High	PCT/L&S	6.0	3.8	2.6
25	PP	Immature	High	PCT or CT/NMT	9.8	6.8	5.1
26	PP	Immature	High	CT/Pile	1.0	1.0	1.0
27	PP	Immature	High	CT/L&S	6.0	3.8	2.6
28	PP	Mature	Low	Logged	13.0	8.0	5.0
29	PP	Mature	Low	Logged/NMT	13.0	8.0	5.0
30	PP	Mature	Low	Logged/Crush	6.0	3.0	2.0
31	PP	Mature	Low	Logged/YUM	6.8	4.5	3.4
32	PP	Mature	Medium	Logged	13.0	8.0	5.0
33	PP	Mature	Medium	Logged/NMT	13.0	8.0	5.0
34	PP	Mature	Medium	Logged/Crush	6.0	3.0	2.0
35	PP	Mature	Medium	Logged/YUM	13.0	8.0	5.0
36	PP	Mature	High	Logged	20.0	12.0	7.0
37	PP	Mature	High	Logged/NMT	20.0	12.0	7.0
38	PP	Mature	High	Logged/Crush	11.0	7.0	4.0
39	PP	Mature	High	Logged/YUM	13.0	8.0	5.0
40	PP	Overmature	Low	Logged	13.0	8.0	5.0
41	PP	Overmature	Low	Logged/NMT	13.0	8.0	5.0

Table B-3 Spread Components Used in FETM[1]							
	Vegetation	Age	Loading	Activity	Spread Component (feet/minute)		
FCC	Type	Class	Class	Class	Extreme	V. High	High
42	PP	Overmature	Low	Logged/Crush	6.0	3.0	2.0
43	PP	Overmature	Low	Logged/YUM	13.0	8.0	5.0
44	PP	Overmature	Medium	Logged	6.8	4.5	3.4
45	PP	Overmature	Medium	Logged/NMT	6.8	4.5	3.4
46	PP	Overmature	Medium	Logged/Crush	2.3	1.5	0.9
47	PP	Overmature	Medium	Logged/YUM	9.0	6.0	4.0
48	PP	Overmature	High	Logged	23.0	13.0	7.0
49	PP	Overmature	High	Logged/NMT	23.0	13.0	7.0
50	PP	Overmature	High	Logged/Crush	9.0	5.0	3.0
51	PP	Overmature	High	Logged/YUM	17.0	11.0	6.0
52	MC	Bare	Low		2.3	1.5	0.9
53	MC	Bare	Medium		2.3	1.5	0.9
54	MC	Bare	High		1.5	0.8	0.9
55	MC	Immature	Low		2.3	1.5	0.9
56	MC	Immature	Medium		2.3	1.5	0.9
57	MC	Immature	High		1.5	0.8	0.9
58	MC	Mature	Low		1.5	0.8	0.9
59	MC	Mature	Medium		3.0	2.3	1.7
60	MC	Mature	High		2.3	1.5	0.9
61	MC	Overmature	Low		1.5	0.8	0.9
62	MC	Overmature	Medium		9.8	6.0	3.4
63	MC	Overmature	High		9.0	5.3	4.3
64	MC	Immature	Low	PCT/Pile	1.0	1.0	1.0
65	MC	Immature	Low	PCT/L&S	2.3	1.5	0.9
66	MC	Immature	Low	PCT or CT/NMT	6.8	4.5	3.4
67	MC	Immature	Low	CT/Pile	1.0	1.0	1.0
68	MC	Immature	Low	CT/L&S	2.3	1.5	0.9
69	MC	Immature	Medium	PCT/Pile	1.0	1.0	1.0
70	MC	Immature	Medium	PCT/L&S	6.0	3.8	2.6
71	MC	Immature	Medium	PCT or CT/NMT	12.8	8.3	6.0
72	MC	Immature	Medium	CT/Pile	1.0	1.0	1.0
73	MC	Immature	Medium	CT/L&S	6.0	3.0	2.0
74	MC	Immature	High	PCT/Pile	1.0	1.0	1.0
75	MC	Immature	High	PCT/L&S	6.0	3.8	2.6
76	MC	Immature	High	PCT or CT/NMT	12.8	8.3	6.0
77	MC	Immature	High	CT/Pile	1.0	1.0	1.0
78	MC	Immature	High	CT/L&S	6.0	3.8	2.6
79	MC	Mature	Low	Logged	25.0	16.0	9.0
80	MC	Mature	Low	Logged/NMT	25.0	16.0	9.0
81	MC	Mature	Low	Logged/Crush	6.0	3.0	2.0
82	MC	Mature	Low	Logged/YUM	13.0	8.0	5.0
83	MC	Mature	Medium	Logged	6.8	4.5	3.4

Table B-3 Spread Components Used in FETM[1]							
	Vegetation	Age	Loading	Activity	Spread Component (feet/minute)		
FCC	Type	Class	Class	Class	Extreme	V. High	High
84	MC	Mature	Medium	Logged/NMT	6.8	4.5	3.4
85	MC	Mature	Medium	Logged/Crush	2.3	1.5	0.9
86	MC	Mature	Medium	Logged/YUM	13.0	8.0	5.0
87	MC	Mature	High	Logged	17.0	11.0	6.0
88	MC	Mature	High	Logged/NMT	17.0	11.0	6.0
89	MC	Mature	High	Logged/Crush	10.0	7.0	4.0
90	MC	Mature	High	Logged/YUM	17.0	11.0	6.0
91	MC	Overmature	Low	Logged	13.0	8.0	5.0
92	MC	Overmature	Low	Logged/NMT	13.0	8.0	5.0
93	MC	Overmature	Low	Logged/Crush	13.0	8.0	5.0
94	MC	Overmature	Low	Logged/YUM	6.0	3.0	2.0
95	MC	Overmature	Medium	Logged	17.0	11.0	6.0
96	MC	Overmature	Medium	Logged/NMT	17.0	11.0	6.0
97	MC	Overmature	Medium	Logged/Crush	17.0	11.0	6.0
98	MC	Overmature	Medium	Logged/YUM	10.0	7.0	4.0
99	MC	Overmature	High	Logged	17.0	11.0	6.0
100	MC	Overmature	High	Logged/NMT	17.0	11.0	6.0
101	MC	Overmature	High	Logged/Crush	17.0	11.0	6.0
102	MC	Overmature	High	Logged/YUM	10.0	7.0	4.0
103	LP	Bare	Low		3.0	2.0	1.0
104	LP	Bare	Medium		3.0	2.0	1.0
105	LP	Bare	High		7.0	4.0	2.0
106	LP	Immature	Low		2.3	1.5	0.9
107	LP	Immature	Medium		9.0	5.3	4.3
108	LP	Immature	High		11.3	7.5	5.1
109	LP	Mature	Low		2.3	1.5	0.9
110	LP	Mature	Medium		9.0	5.3	4.3
111	LP	Mature	High		9.0	5.3	4.3
112	LP	Overmature	Low		1.5	0.8	0.9
113	LP	Overmature	Medium		2.3	1.5	0.9
114	LP	Overmature	High		9.0	5.3	4.3
115	LP	Immature	Low	PCT/Pile	1.0	1.0	1.0
116	LP	Immature	Low	PCT/L&S	2.3	1.5	0.9
117	LP	Immature	Low	PCT or CT/NMT	4.5	2.3	1.7
118	LP	Immature	Low	CT/Pile	1.0	1.0	1.0
119	LP	Immature	Low	CT/L&S	2.3	1.5	0.9
120	LP	Immature	Medium	PCT/Pile	1.0	1.0	1.0
121	LP	Immature	Medium	PCT/L&S	7.5	5.3	3.4
122	LP	Immature	Medium	PCT or CT/NMT	9.0	6.0	4.3
123	LP	Immature	Medium	CT/Pile	1.0	1.0	1.0
124	LP	Immature	Medium	CT/L&S	2.3	1.5	0.9
125	LP	Immature	High	PCT/Pile	1.0	1.0	1.0

Table B-3
Spread Components Used in FETM[1]

FCC	Vegetation Type	Age Class	Loading Class	Activity Class	Spread Component (feet/minute) Extreme	V. High	High
126	LP	Immature	High	PCT/L&S	6.0	3.8	2.6
127	LP	Immature	High	PCT or CT/NMT	9.8	6.8	5.1
128	LP	Immature	High	CT/Pile	1.0	1.0	1.0
129	LP	Immature	High	CT/L&S	6.0	3.8	2.6
130	LP	Mature	Low	Logged	23.0	13.0	7.0
131	LP	Mature	Low	Logged/NMT	23.0	13.0	7.0
132	LP	Mature	Low	Logged/Crush	9.0	5.0	3.0
133	LP	Mature	Low	Logged/YUM	23.0	13.0	7.0
134	LP	Mature	Medium	Logged	6.8	4.5	3.4
135	LP	Mature	Medium	Logged/NMT	6.8	4.5	3.4
136	LP	Mature	Medium	Logged/Crush	2.3	1.5	0.9
137	LP	Mature	Medium	Logged/YUM	6.8	4.5	3.4
138	LP	Mature	High	Logged	9.0	6.0	4.3
139	LP	Mature	High	Logged/NMT	9.0	6.0	4.3
140	LP	Mature	High	Logged/Crush	7.5	5.3	3.4
141	LP	Mature	High	Logged/YUM	9.0	6.0	4.3
142	LP	Overmature	Low	Logged	6.8	4.5	3.4
143	LP	Overmature	Low	Logged/NMT	6.8	4.5	3.4
144	LP	Overmature	Low	Logged/Crush	2.3	1.5	0.9
145	LP	Overmature	Low	Logged/YUM	6.8	4.5	3.4
146	LP	Overmature	Medium	Logged	6.8	4.5	3.4
147	LP	Overmature	Medium	Logged/NMT	6.8	4.5	3.4
148	LP	Overmature	Medium	Logged/Crush	2.3	1.5	0.9
149	LP	Overmature	Medium	Logged/YUM	6.8	4.5	3.4
150	LP	Overmature	High	Logged	9.0	6.0	4.3
151	LP	Overmature	High	Logged/NMT	9.0	6.0	4.3
152	LP	Overmature	High	Logged/Crush	7.5	5.3	3.4
153	LP	Overmature	High	Logged/YUM	9.0	6.0	4.3
154	WJ	Bare	Low		41.0	13.0	4.0
155	WJ	Bare	Medium		41.0	13.0	4.0
156	WJ	Bare	High		41.0	13.0	4.0
157	WJ	Immature	Low		41.0	13.0	4.0
158	WJ	Immature	Medium		41.0	13.0	4.0
159	WJ	Immature	High		41.0	13.0	4.0
160	WJ	Mature	Low		49.0	18.0	6.0
161	WJ	Mature	Medium		49.0	18.0	6.0
162	WJ	Mature	High		49.0	18.0	6.0
163	Grass	Mature	Low		40.0	29.0	20.0
164	Grass/PP	Mature	Low		18.8	12.0	7.7
165	Grass/LP	Mature	Low		4.5	3.0	1.7
166	Grass	Mature	Medium		47.0	30.0	16.0
167	Grass/PP	Mature	Medium		3.0	2.3	1.7

Table B-3
Spread Components Used in FETM[1]

FCC	Vegetation Type	Age Class	Loading Class	Activity Class	Spread Component (feet/minute) Extreme	V. High	High
168	Grass/LP	Mature	Medium		3.0	2.3	1.7
169	Grass	Mature	High		47.0	30.0	16.0
170	Grass/PP	Mature	High		4.5	3.0	1.7
171	Grass/LP	Mature	High		2.3	1.5	0.9
172	Shrub	Immature	Low		30.0	9.0	5.0
173	Shrub	Immature	Medium		30.0	9.0	5.0
174	Shrub	Immature	High		30.0	9.0	5.0
175	Shrub	Mature	Low		30.0	9.0	5.0
176	Shrub	Mature	Medium		30.0	9.0	5.0
177	Shrub	Mature	High		30.0	9.0	5.0
178	Shrub/MC	Immature	Low		9.0	5.3	3.4
179	Shrub/MC	Immature	Medium		13.5	8.3	4.3
180	Shrub/MC	Immature	High		38.0	17.0	6.0
181	Shrub/MC	Mature	Low		9.0	5.3	3.4
182	Shrub/MC	Mature	Medium		13.5	8.3	4.3
183	Shrub/MC	Mature	High		38.0	17.0	6.0
184	PP	Mature	Very Low		28.0	12.0	5.0
185	PP	Overmature	Very Low		7.0	4.0	2.0
186	MC	Mature	Very Low		1.5	0.8	0.9
187	MC	Overmature	Very Low		1.5	0.8	0.9
188	LP	Immature	Very Low		1.5	0.8	0.9

[1] From pcFIRDAT runs (California Department of Forestry, 1994); see Appendix A.

Table B-4
Surface Fuel Consumption (tons/acre) for Wildfire and Prescribed Fire[1]

FCC	Wildfire Consumption (By Fire Weather Class) Extreme[2]	Very High[3]	High[4]	Prescribed Fire Consumption[5]
1	10	10	10	8
2	17	16	16	13
3	13	13	13	9
4	16	16	16	10
5	23	23	23	16
6	29	29	29	20
7	16	16	16	8
8	23	23	23	13
9	34	33	33	17
10	21	21	21	11
11	41	41	40	20
12	46	46	45	18
13	19	19	19	12
14	19	19	19	12
15	19	19	19	12
16	21	21	21	14
17	21	21	21	14
18	29	29	29	20
19	29	29	29	20
20	29	29	29	20
21	29	29	29	20
22	29	29	29	20
23	38	38	38	26
24	38	38	38	26
25	38	38	38	26
26	29	29	29	20
27	29	29	29	20
28	23	23	23	16
29	23	23	23	16
30	23	23	23	16
31	18	18	18	13
32	25	25	25	17
33	25	25	25	17
34	25	25	25	17
35	23	23	23	16
36	31	31	31	22
37	31	31	31	22
38	31	31	31	22
39	27	27	26	17
40	24	24	24	17
41	24	24	24	17

Table B-4 Surface Fuel Consumption (tons/acre) for Wildfire and Prescribed Fire[1]				
	Wildfire Consumption (By Fire Weather Class)			Prescribed Fire
FCC	Extreme[2]	Very High[3]	High[4]	Consumption[5]
42	24	24	24	17
43	23	23	23	16
44	33	33	33	21
45	33	33	33	21
46	33	33	33	21
47	27	27	26	17
48	39	39	38	24
49	39	39	38	24
50	39	39	38	24
51	33	33	32	22
52	10	10	10	9
53	13	13	13	10
54	19	19	19	10
55	19	19	19	11
56	24	23	23	13
57	30	30	30	15
58	26	25	25	11
59	39	39	39	19
60	53	53	52	23
61	25	25	25	11
62	43	43	42	21
63	60	60	59	29
64	23	23	23	16
65	23	23	23	16
66	23	23	23	16
67	23	23	23	16
68	23	23	23	16
69	34	34	34	25
70	34	34	34	25
71	34	34	34	25
72	26	26	26	17
73	26	26	26	17
74	41	41	41	30
75	41	41	41	30
76	41	41	41	30
77	34	34	34	25
78	34	34	34	25
79	33	32	32	17
80	33	32	32	17
81	33	32	32	17
82	23	23	23	13
83	46	45	45	22

Table B-4 Surface Fuel Consumption (tons/acre) for Wildfire and Prescribed Fire[1]				
	Wildfire Consumption (By Fire Weather Class)			Prescribed Fire
FCC	Extreme[2]	Very High[3]	High[4]	Consumption[5]
84	46	45	45	22
85	46	45	45	22
86	28	28	28	15
87	50	50	49	23
88	50	50	49	23
89	50	50	49	23
90	34	34	34	18
91	35	35	35	17
92	35	35	35	17
93	35	35	35	17
94	27	27	27	15
95	44	44	43	22
96	44	44	43	22
97	44	44	43	22
98	35	35	35	17
99	50	50	49	23
100	50	50	49	23
101	50	50	49	23
102	36	36	36	18
103	7	7	7	6
104	13	13	13	11
105	17	16	16	13
106	11	11	11	10
107	16	16	16	14
108	23	23	23	20
109	11	11	11	10
110	22	22	22	17
111	37	36	36	24
112	15	15	15	9
113	31	31	31	19
114	44	44	44	28
115	19	19	19	11
116	19	19	19	11
117	19	19	19	11
118	20	20	20	12
119	20	20	20	12
120	28	28	28	18
121	28	28	28	18
122	28	28	28	18
123	26	26	26	16
124	26	26	26	16
125	41	41	41	26

Table B-4 Surface Fuel Consumption (tons/acre) for Wildfire and Prescribed Fire[1]				
	Wildfire Consumption (By Fire Weather Class)			Prescribed Fire
FCC	Extreme[2]	Very High[3]	High[4]	Consumption[5]
126	41	41	41	26
127	41	41	41	26
128	35	35	35	26
129	35	35	35	26
130	17	17	17	13
131	17	17	17	13
132	17	17	17	13
133	16	16	16	12
134	24	24	24	17
135	24	24	24	17
136	24	24	24	17
137	20	20	20	15
138	34	34	34	24
139	34	34	34	24
140	34	34	34	24
141	26	26	26	19
142	17	17	17	12
143	17	17	17	12
144	17	17	17	12
145	15	15	15	11
146	24	24	24	17
147	24	24	24	17
148	24	24	24	17
149	20	20	20	14
150	34	34	34	24
151	34	34	34	24
152	34	34	34	24
153	26	26	26	20
154	3	3	3	3
155	3	3	3	3
156	3	3	3	3
157	3	3	3	3
158	3	3	3	3
159	3	3	3	3
160	5	5	5	5
161	5	5	5	5
162	5	5	5	5
163	1	1	1	1
164	11	11	11	6
165	10	10	10	7
166	1	1	1	1
167	16	16	16	8

Table B-4
Surface Fuel Consumption (tons/acre) for Wildfire and Prescribed Fire[1]

FCC	Wildfire Consumption (By Fire Weather Class) Extreme[2]	Very High[3]	High[4]	Prescribed Fire Consumption[5]
168	11	11	11	8
169	1	1	1	1
170	21	21	21	12
171	23	23	23	16
172	6	6	6	5
173	7	7	7	5
174	8	8	8	5
175	8	8	8	5
176	8	8	8	5
177	8	8	8	6
178	20	20	20	11
179	23	23	23	13
180	28	28	28	17
181	26	26	26	12
182	37	36	36	20
183	51	51	50	23
184	15	15	15	8
185	13	13	13	9
186	18	18	18	9
187	17	17	17	8
188	8	8	8	7

[1] Source: Ward and Hardy (1991)
[2] At 8% 1,000-hour fuel moisture content
[3] At 10% 1,000-hour fuel moisture content
[4] At 12% 1,000-hour fuel moisture content
[5] At 40% 1,000-hour fuel moisture content

Table B-5 Wildfire and Prescribed Fire Emission Factors[1,2]		
FCC	Wildfire	Prescribed Fire
1	19.5	18.9
2	18.0	17.3
3	19.4	19.2
4	18.3	20.8
5	17.9	19.6
6	17.5	18.8
7	17.2	23.6
8	15.6	15.0
9	19.2	21.0
10	18.6	20.7
11	20.0	20.9
12	22.1	21.8
13	14.6	18.1
14	14.7	19.7
15	14.7	19.7
16	15.2	17.6
17	15.3	19.1
18	15.0	16.6
19	15.0	17.8
20	15.0	17.8
21	15.0	16.6
22	15.0	17.8
23	16.3	17.5
24	16.3	18.1
25	16.3	18.1
26	14.8	16.9
27	14.9	17.7
28	17.1	18.4
29	17.1	18.4
30	17.1	18.4
31	16.8	19.0
32	17.5	18.7
33	17.5	18.7
34	17.5	18.7
35	16.8	18.3
36	17.0	17.7
37	17.0	17.7
38	17.0	17.7
39	17.7	18.7
40	17.2	18.4
41	17.2	18.4
42	17.2	18.4

Table B-5
Wildfire and Prescribed Fire Emission Factors[1,2]

FCC	Wildfire	Prescribed Fire
43	17.1	18.4
44	18.6	18.7
45	18.6	18.7
46	18.6	18.7
47	17.7	18.7
48	19.2	18.7
49	19.2	18.7
50	19.2	18.7
51	17.5	18.2
52	17.4	17.4
53	18.9	18.2
54	21.8	19.4
55	15.8	21.0
56	17.4	21.0
57	20.0	21.4
58	20.8	22.6
59	20.6	21.4
60	21.3	21.3
61	20.3	21.5
62	19.0	20.8
63	19.6	20.9
64	15.5	17.7
65	15.6	19.1
66	15.6	19.1
67	15.5	17.7
68	15.6	19.1
69	15.4	16.0
70	15.4	17.0
71	15.4	17.0
72	16.2	18.1
73	16.3	19.2
74	15.9	16.6
75	16.0	17.2
76	16.0	17.2
77	15.4	16.0
78	15.4	17.0
79	19.3	20.8
80	19.3	20.8
81	19.3	20.8
82	19.0	20.5
83	19.6	20.4
84	19.6	20.4
85	19.6	20.4

Table B-5 Wildfire and Prescribed Fire Emission Factors[1,2]		
FCC	Wildfire	Prescribed Fire
86	19.4	21.1
87	19.9	20.4
88	19.9	20.4
89	19.9	20.4
90	19.4	20.7
91	19.6	20.9
92	19.6	20.9
93	19.6	20.9
94	19.4	21.1
95	19.1	20.2
96	19.1	20.2
97	19.1	20.2
98	18.8	20.4
99	19.9	20.4
100	19.9	20.4
101	19.9	20.4
102	19.5	20.7
103	19.0	18.9
104	18.0	17.5
105	18.2	17.5
106	19.3	19.3
107	18.4	17.8
108	18.0	17.1
109	19.0	19.8
110	18.0	18.0
111	19.3	18.2
112	19.0	21.4
113	20.8	19.8
114	19.7	18.8
115	16.7	17.5
116	16.8	18.9
117	16.8	18.9
118	16.0	16.8
119	16.0	18.2
120	17.5	17.0
121	17.5	17.9
122	17.5	17.9
123	16.8	17.1
124	16.8	18.1
125	17.0	16.9
126	17.0	17.2
127	17.0	17.2
128	16.0	15.3

Table B-5 Wildfire and Prescribed Fire Emission Factors[1,2]		
FCC	**Wildfire**	**Prescribed Fire**
129	16.0	16.0
130	17.7	18.6
131	17.7	18.6
132	18.2	19.0
133	17.5	18.9
134	18.6	18.9
135	18.6	18.9
136	18.6	18.9
137	17.9	18.8
138	18.8	18.2
139	18.8	18.2
140	18.8	18.2
141	17.8	18.0
142	17.2	18.7
143	17.2	18.7
144	17.2	18.7
145	16.8	19.0
146	18.6	18.9
147	18.6	18.9
148	18.6	18.9
149	17.9	18.8
150	18.8	18.2
151	18.8	18.2
152	18.8	18.2
153	17.8	18.0
154	17.8	17.9
155	17.8	17.9
156	17.8	17.9
157	17.8	17.9
158	17.8	17.9
159	17.8	17.9
160	18.1	18.2
161	18.1	18.2
162	18.1	18.2
163	24.6	26.0
164	18.5	25.0
165	19.4	21.6
166	22.4	23.5
167	17.3	22.0
168	19.1	21.0
169	22.4	23.5
170	17.3	21.2
171	20.5	19.4

Table B-5 Wildfire and Prescribed Fire Emission Factors[1,2]		
FCC	Wildfire	Prescribed Fire
172	17.7	18.3
173	17.5	18.0
174	16.6	16.9
175	16.6	16.9
176	16.2	16.3
177	15.7	15.9
178	17.7	19.8
179	18.6	20.6
180	17.6	19.7
181	18.8	20.9
182	18.9	19.9
183	19.3	20.3
184	15.5	22.6
185	19.4	21.6
186	20.5	22.4
187	20.9	22.0
188	20.3	20.9

[1] Fire-weighted averages from Hardy and Ward (1991)
[2] Units are pounds of PM_{10} per ton of fuel consumed.

Appendix C

FETM Results - Base Scenario - Grande Ronde River Basin, Oregon

Appendix C

FETM Results-Base Scenario-
Grande Ronde River Basin, Oregon

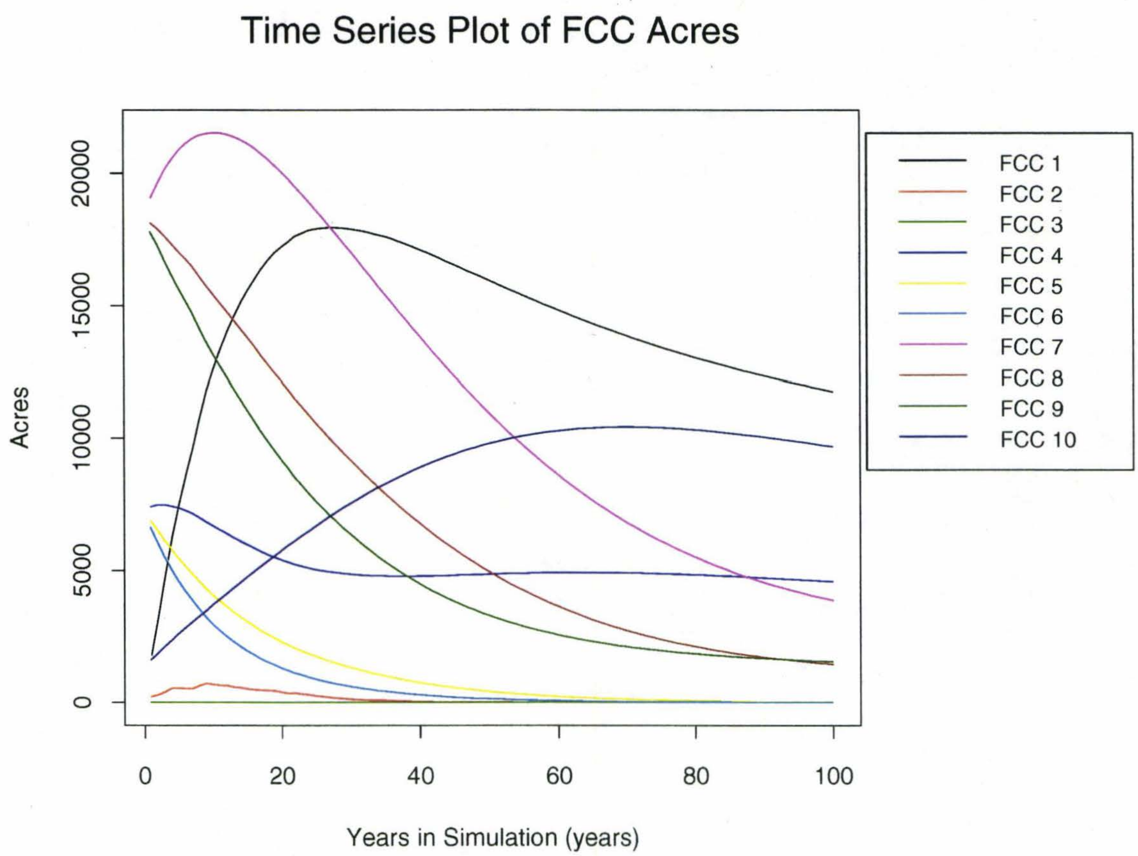


Figure C-1a
Distribution of Acres in Fuel Condition Classes 1-10 Over 100-Year Simulation, Base Scenario

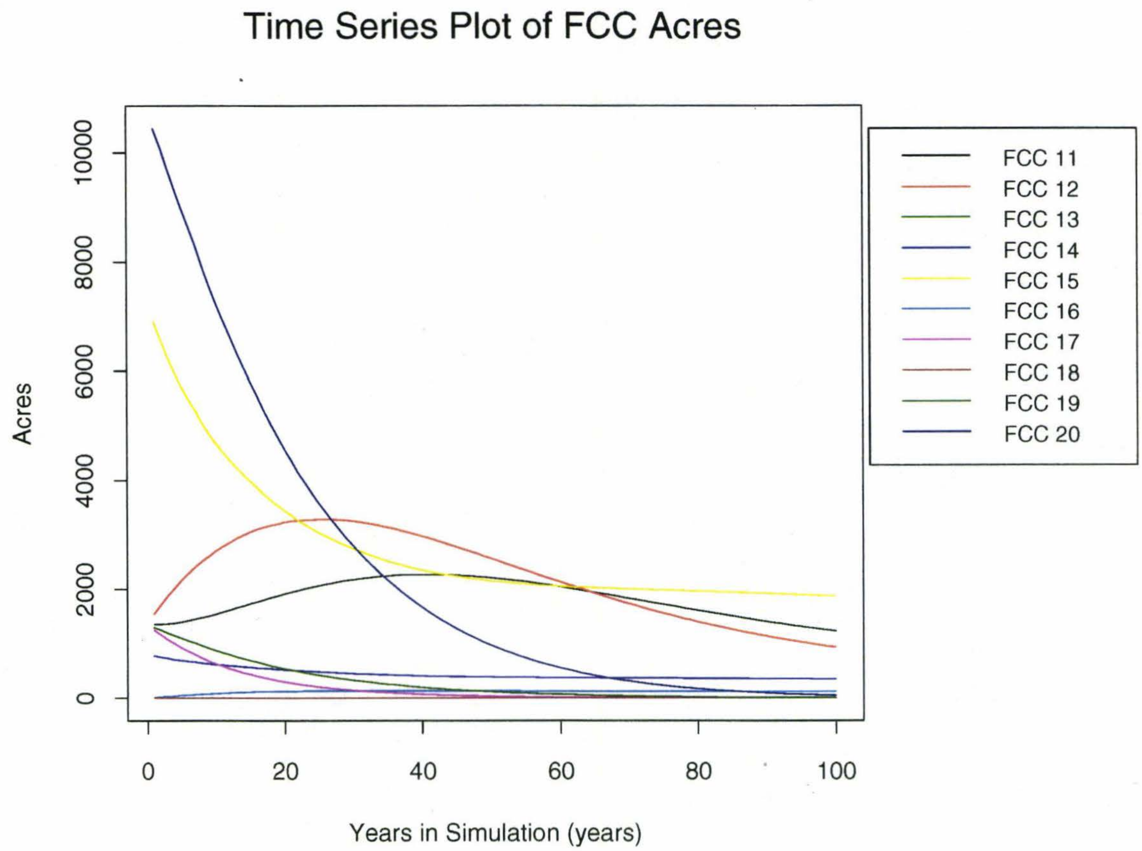


Figure C-1b
Distribution of Acres in Fuel Condition Classes 11-20 Over 100-Year Simulation, Base Scenario

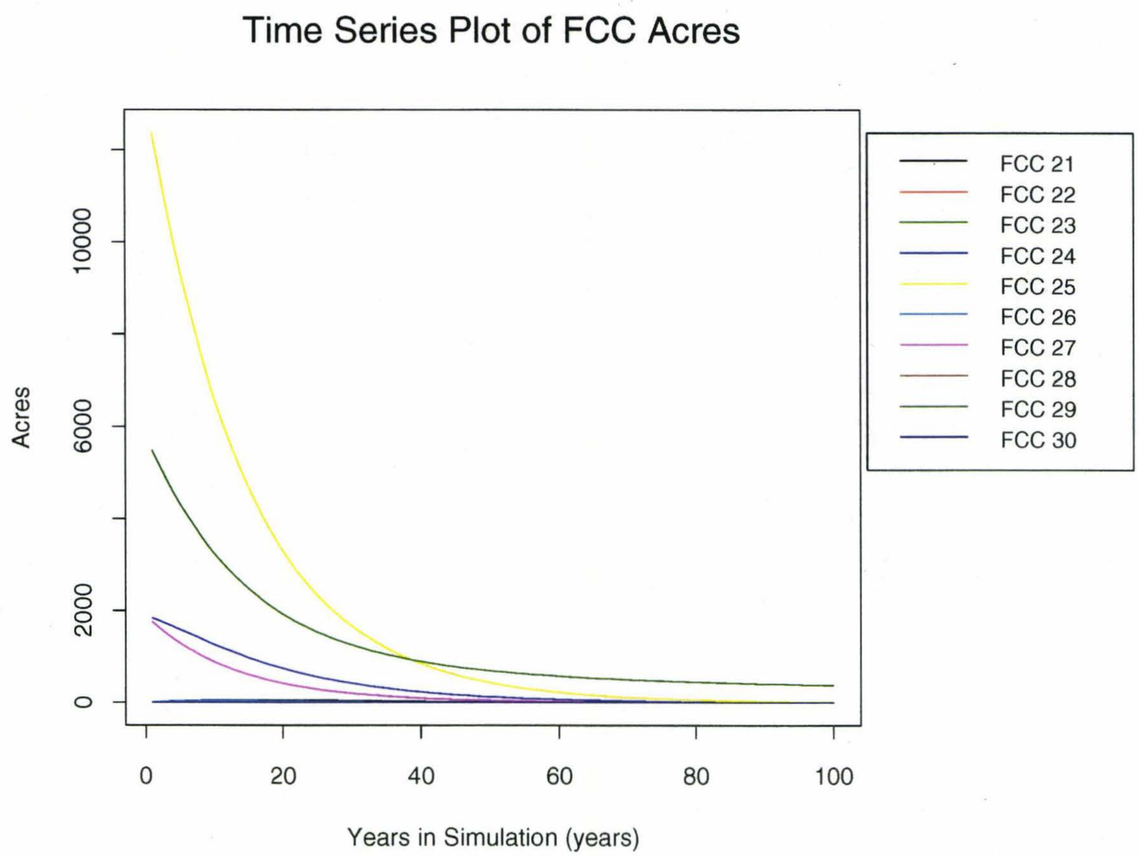


Figure C-1c
Distribution of Acres in Fuel Condition Classes 21-30 Over 100-Year Simulation, Base Scenario

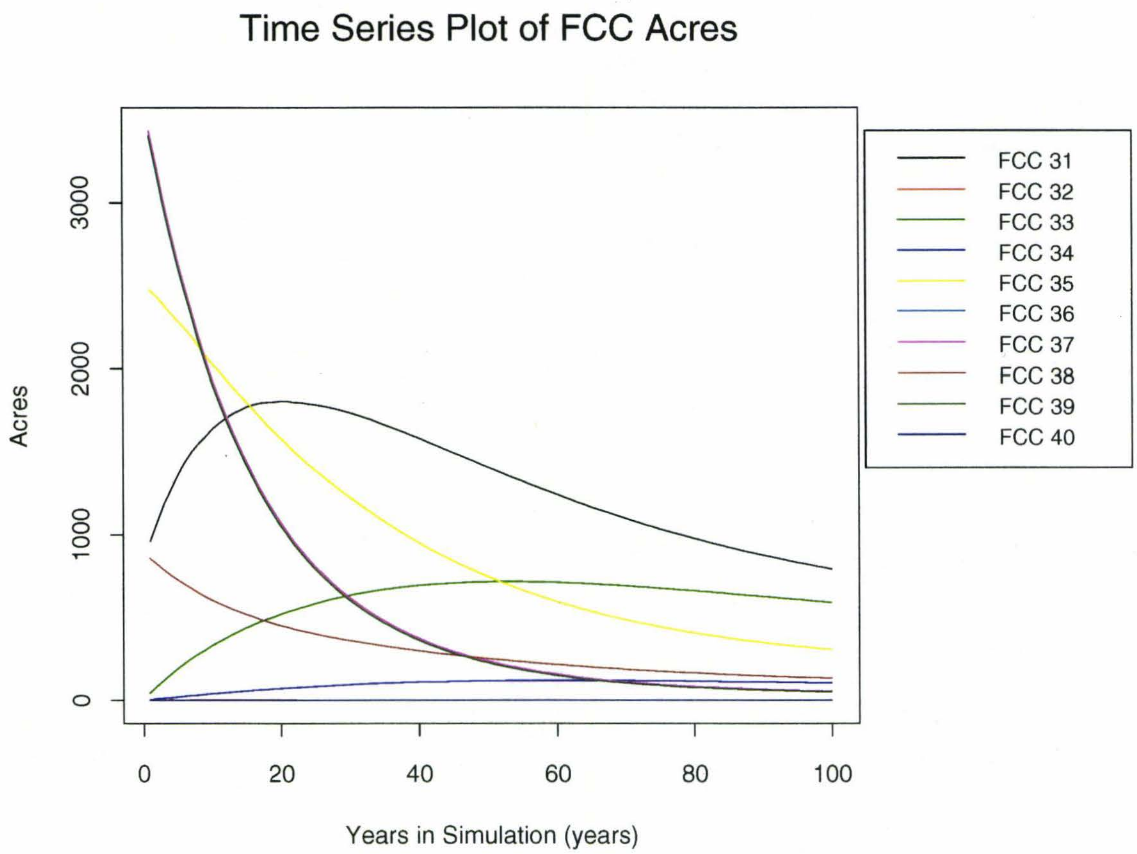


Figure C-1d
Distribution of Acres in Fuel Condition Classes 31-40 Over 100-Year Simulation, Base Scenario

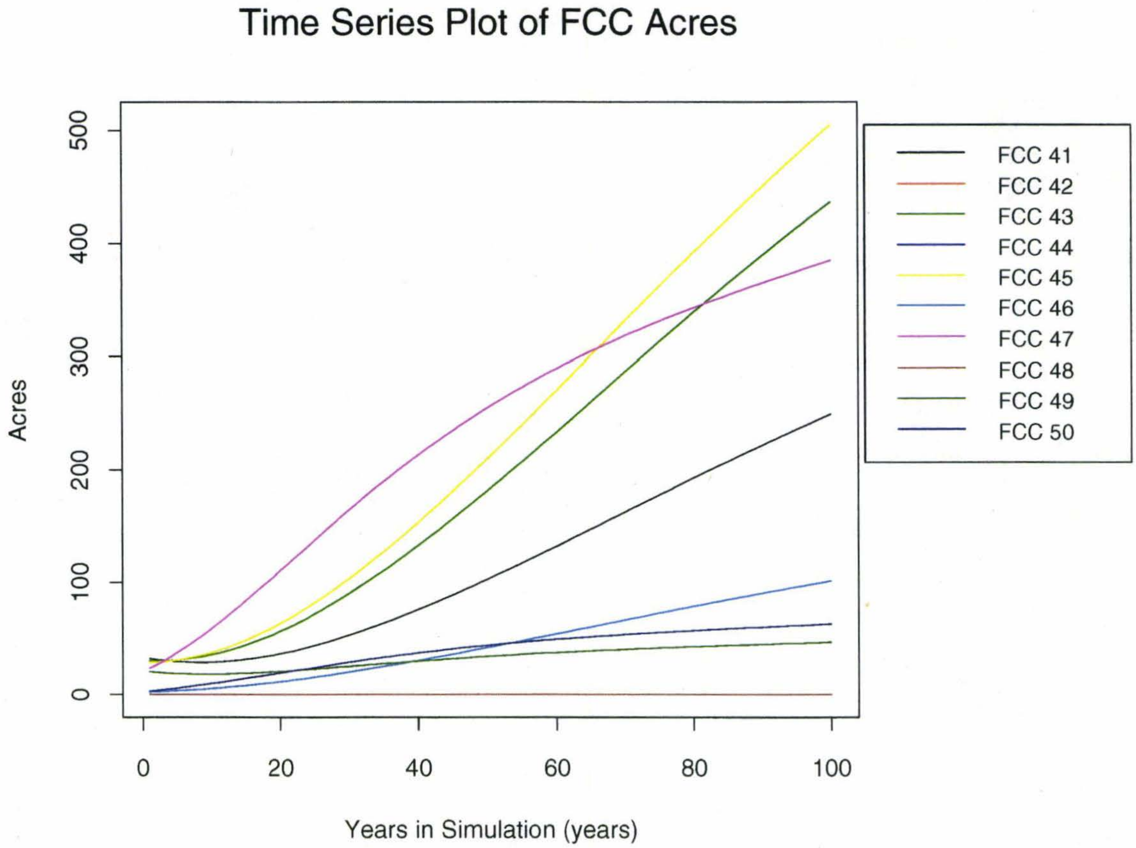


Figure C-1e
Distribution of Acres in Fuel Condition Classes 41-50 Over 100-Year Simulation, Base Scenario

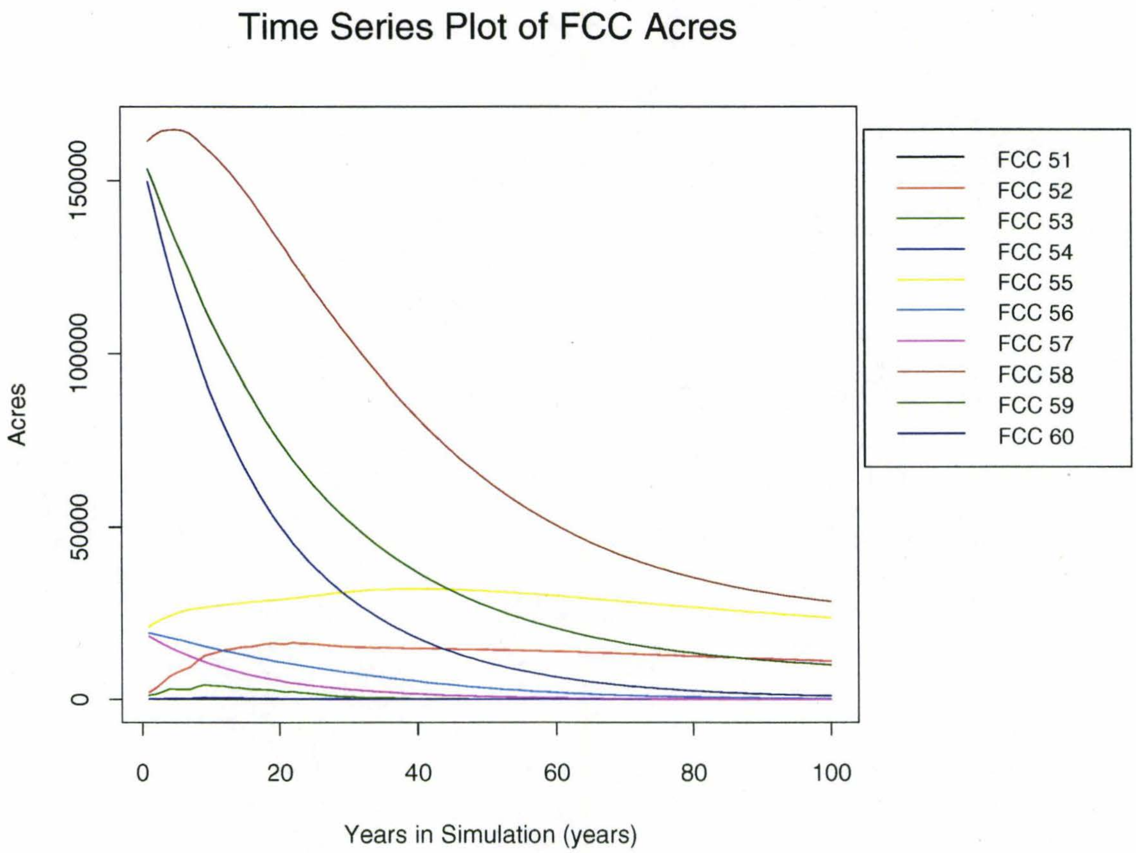


Figure C-1f
Distribution of Acres in Fuel Condition Classes 51-60 Over 100-Year Simulation, Base Scenario

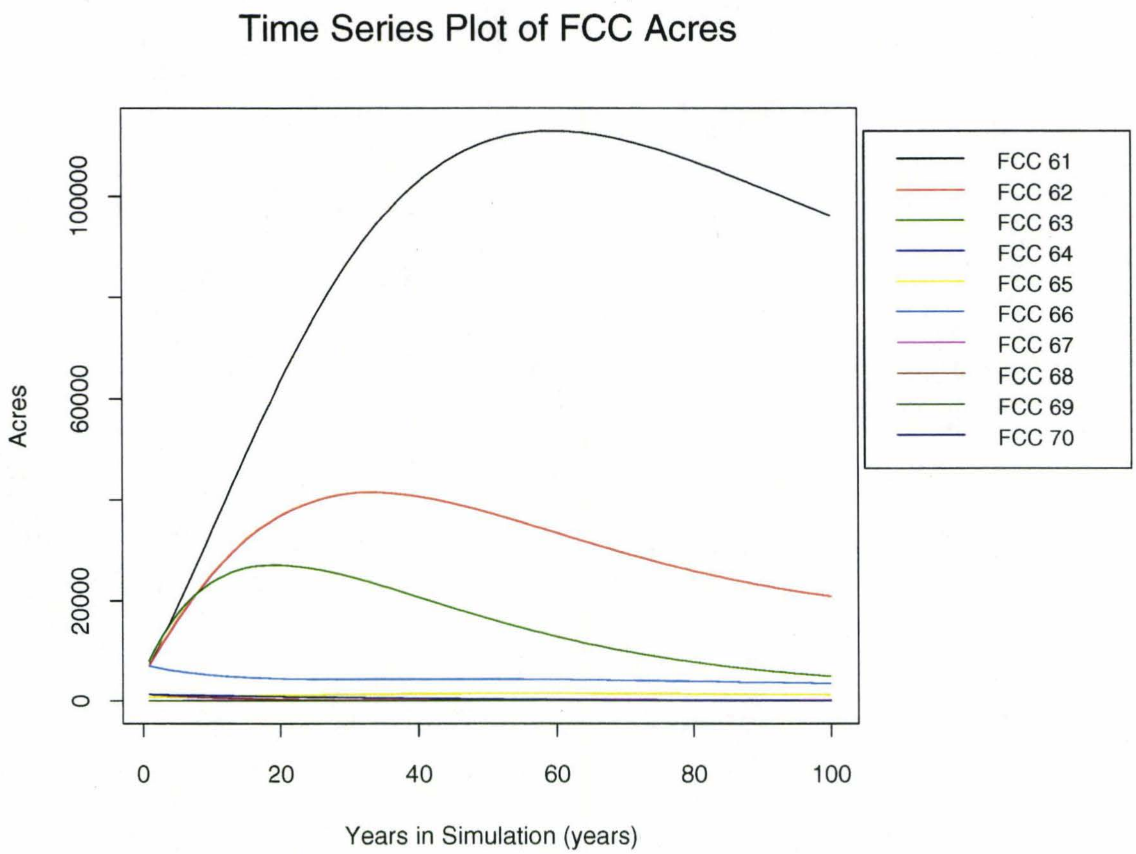


Figure C-1g
Distribution of Acres in Fuel Condition Classes 61-70 Over 100-Year Simulation, Base Scenario

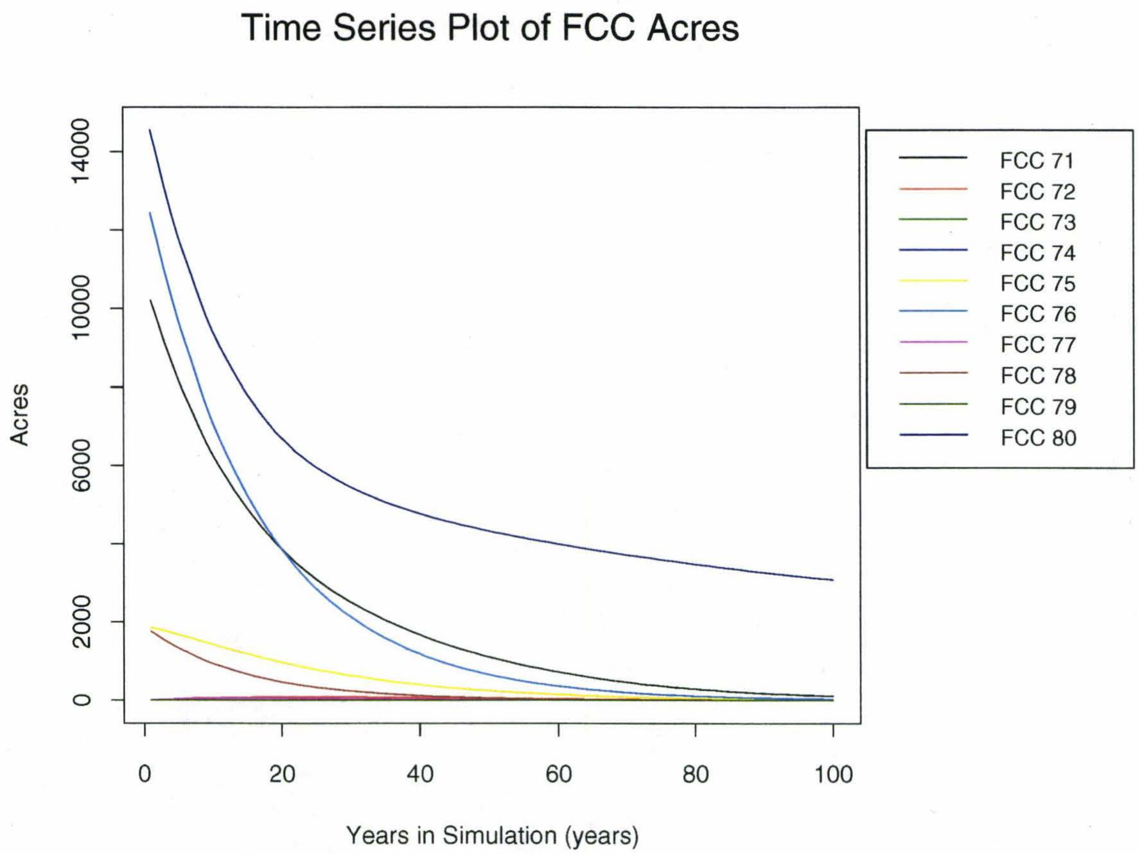


Figure C-1h
Distribution of Acres in Fuel Condition Classes 71-80 Over 100-Year Simulation, Base Scenario

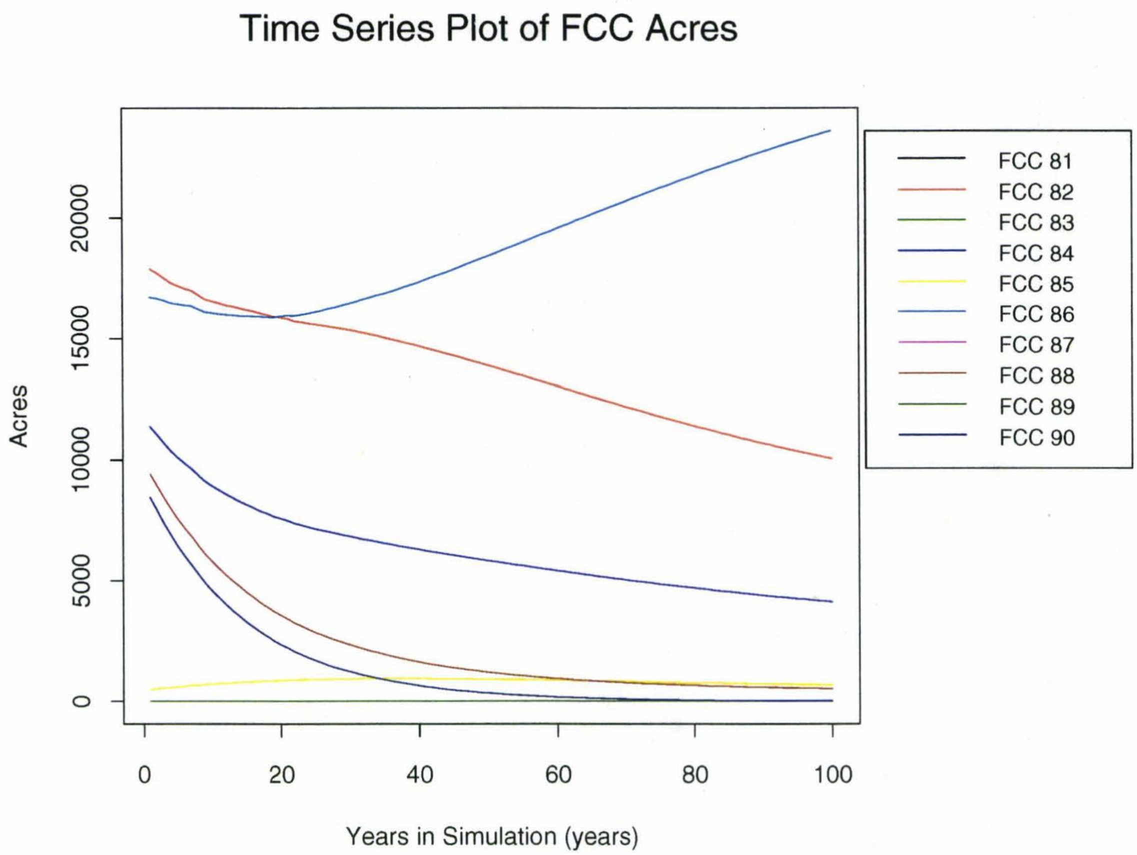


Figure C-1i
Distribution of Acres in Fuel Condition Classes 81-90 Over 100-Year Simulation, Base Scenario

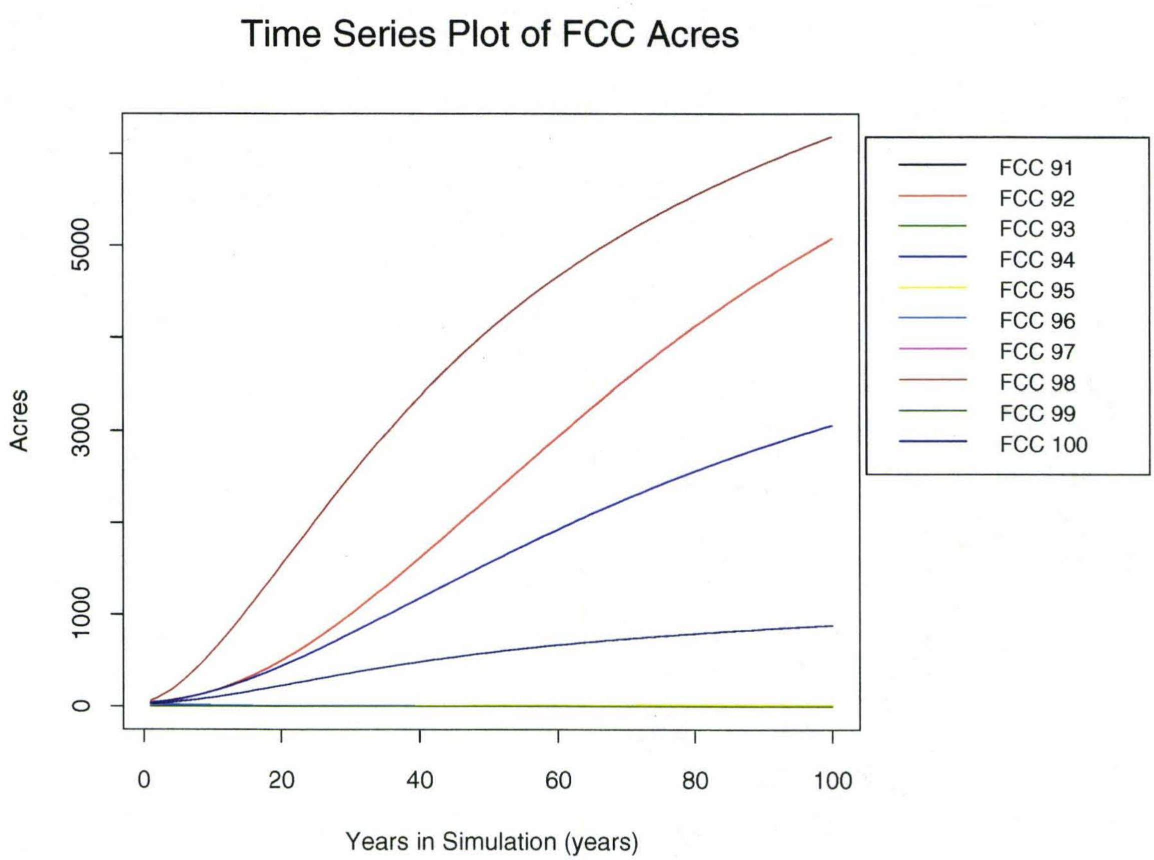


Figure C-1j
Distribution of Acres in Fuel Condition Classes 91-100 Over 100-Year Simulation, Base Scenario

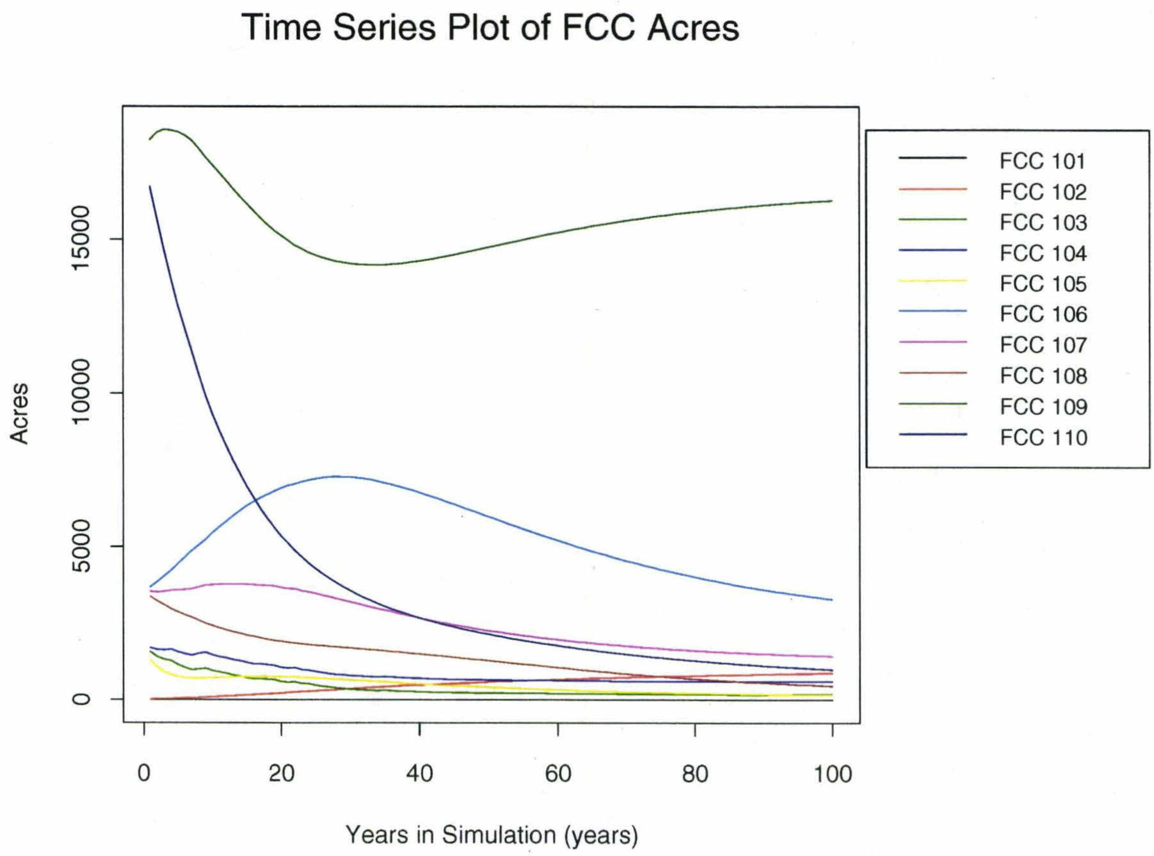


Figure C-1k
Distribution of Acres in Fuel Condition Classes 101-110 Over 100-Year Simulation, Base Scenario

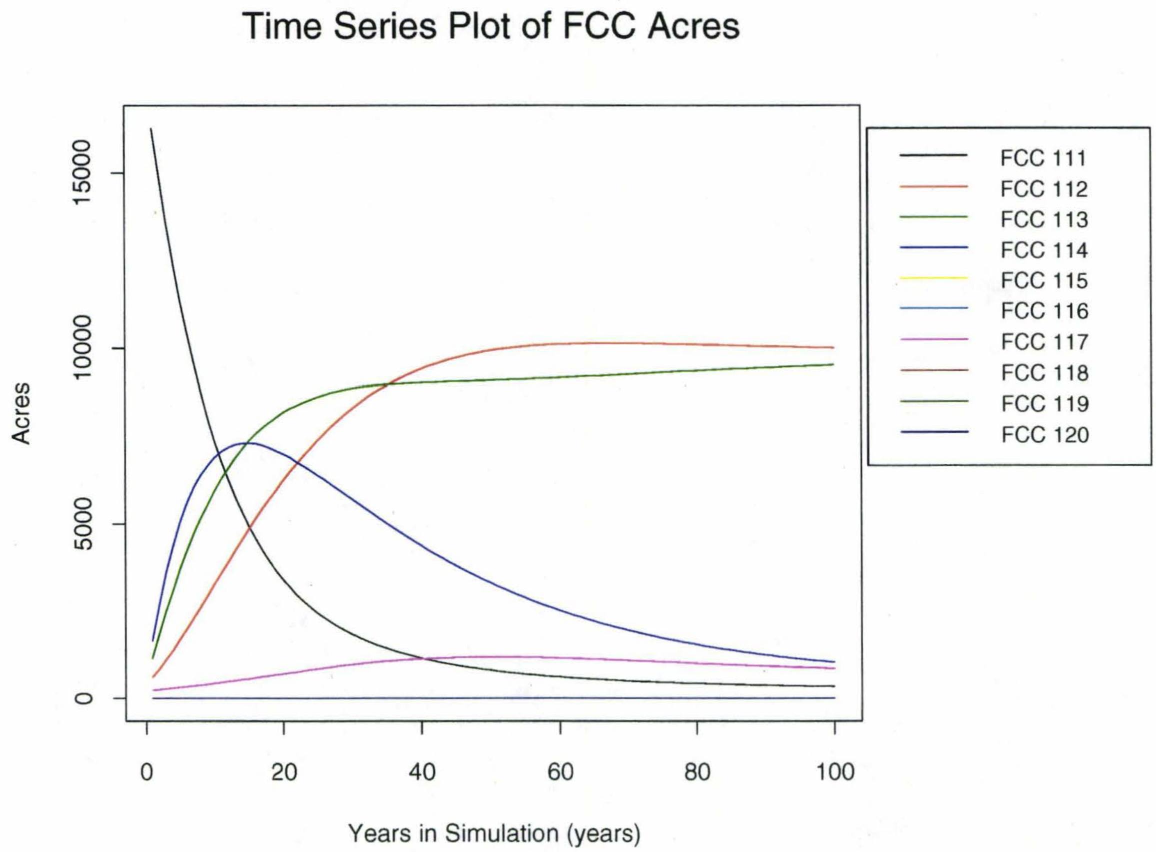


Figure C-11
Distribution of Acres in Fuel Condition Classes 111-120 Over 100-Year Simulation, Base Scenario

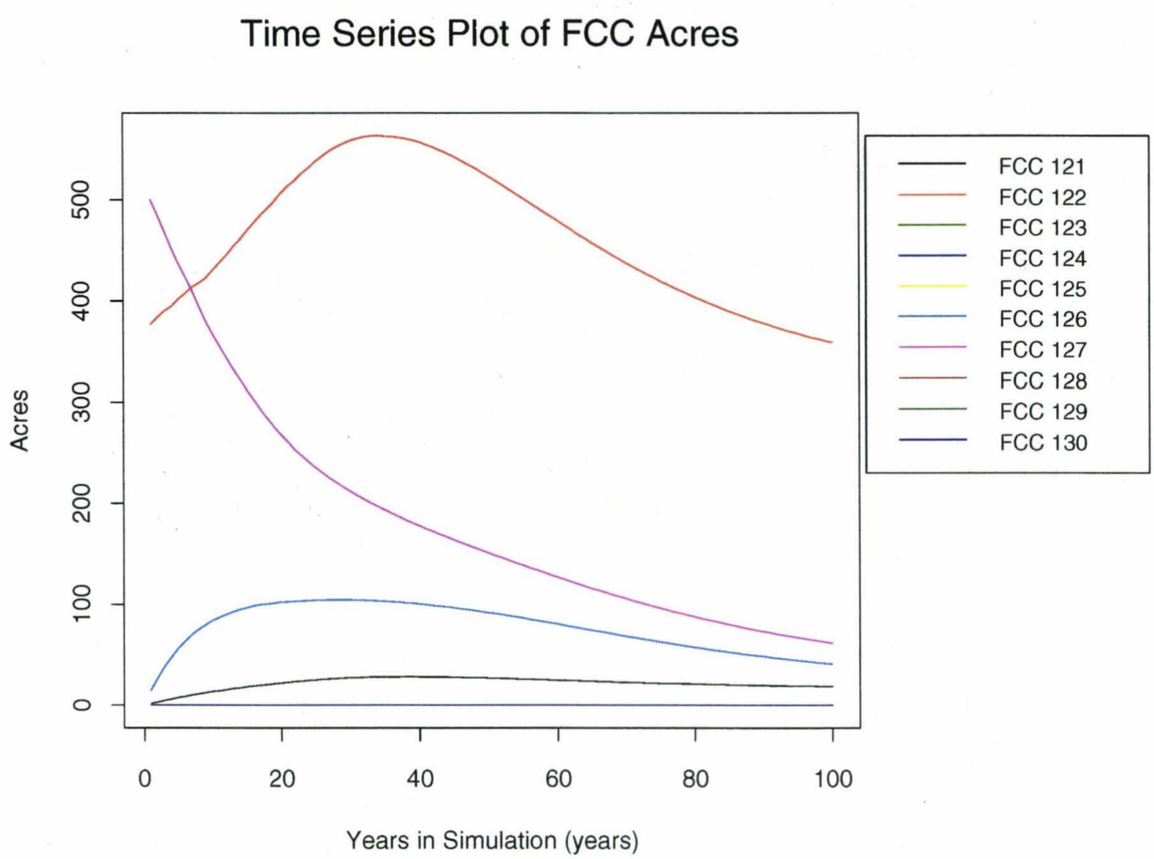


Figure C-1m
Distribution of Acres in Fuel Condition Classes 121-130 Over 100-Year Simulation, Base Scenario

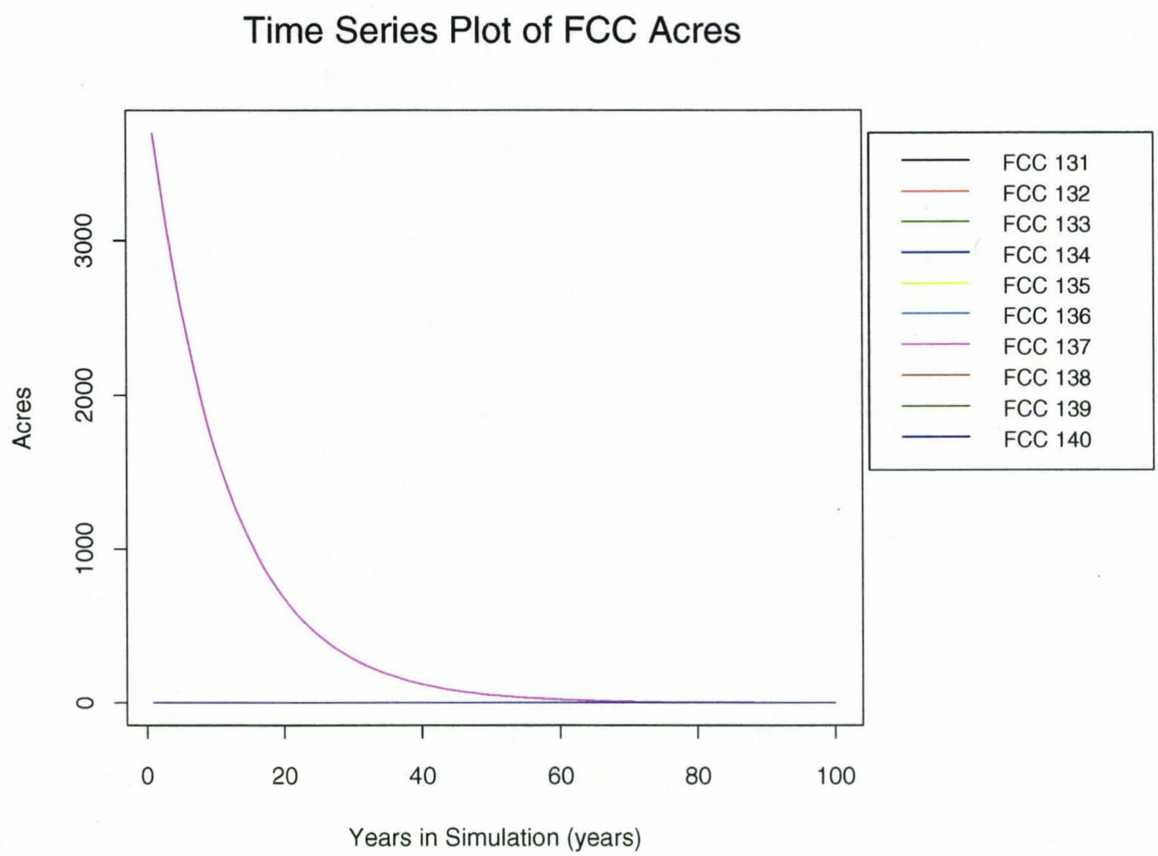


Figure C-1n
Distribution of Acres in Fuel Condition Classes 131-140 Over 100-Year Simulation, Base Scenario

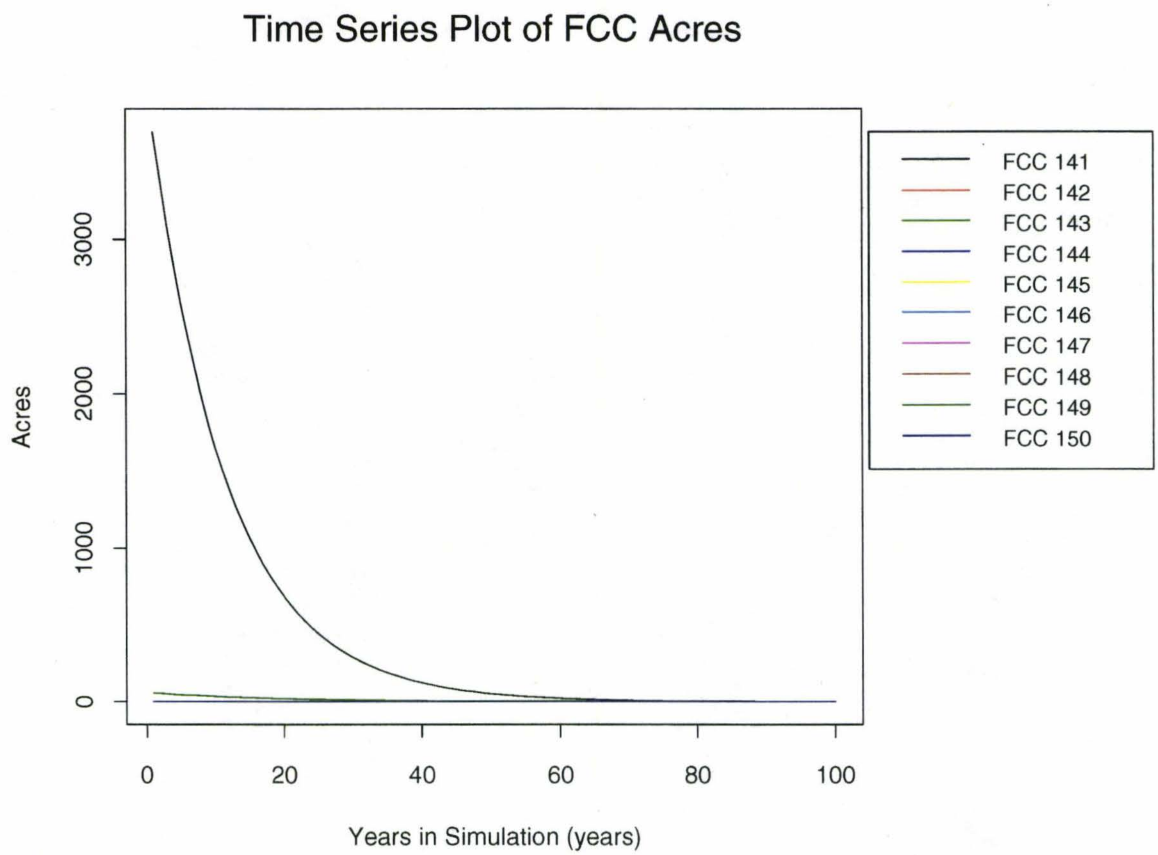


Figure C-1o
Distribution of Acres in Fuel Condition Classes 141-150 Over 100-Year Simulation, Base Scenario

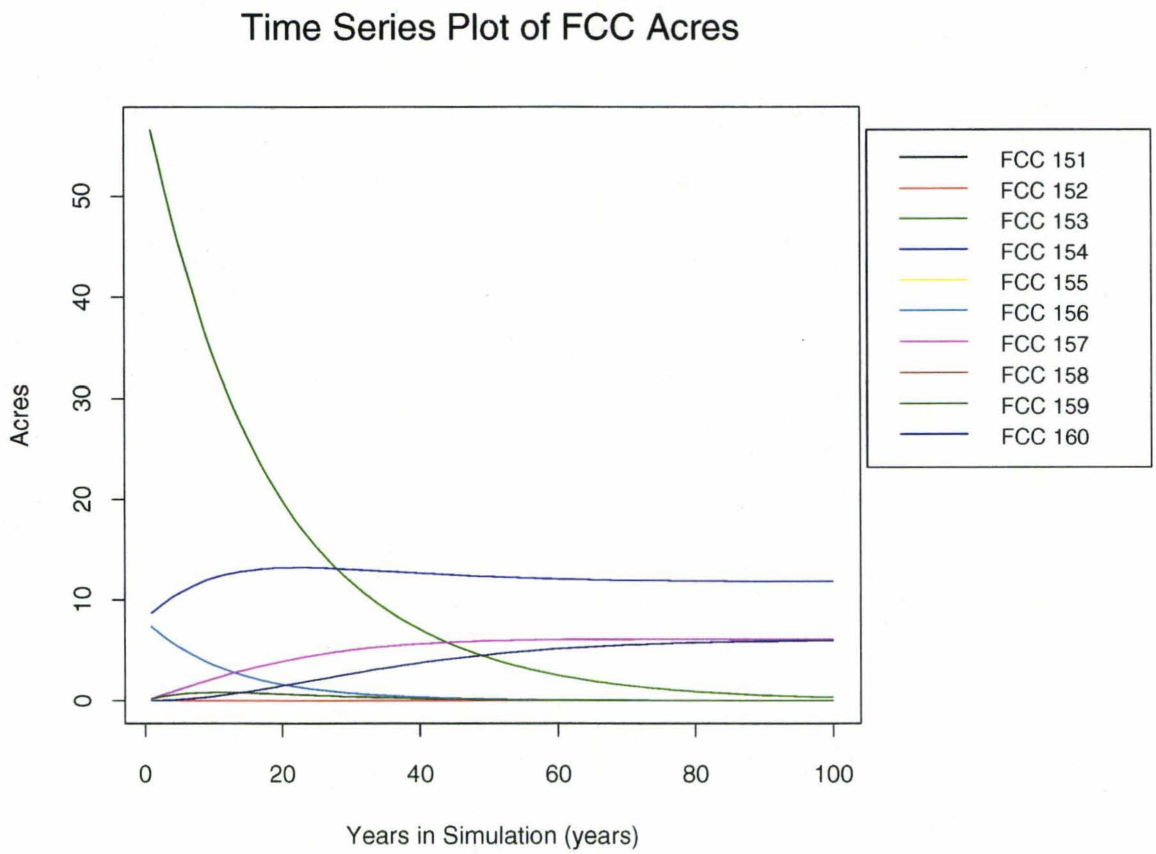


Figure C-1p
Distribution of Acres in Fuel Condition Classes 151-160 Over 100-Year Simulation, Base Scenario

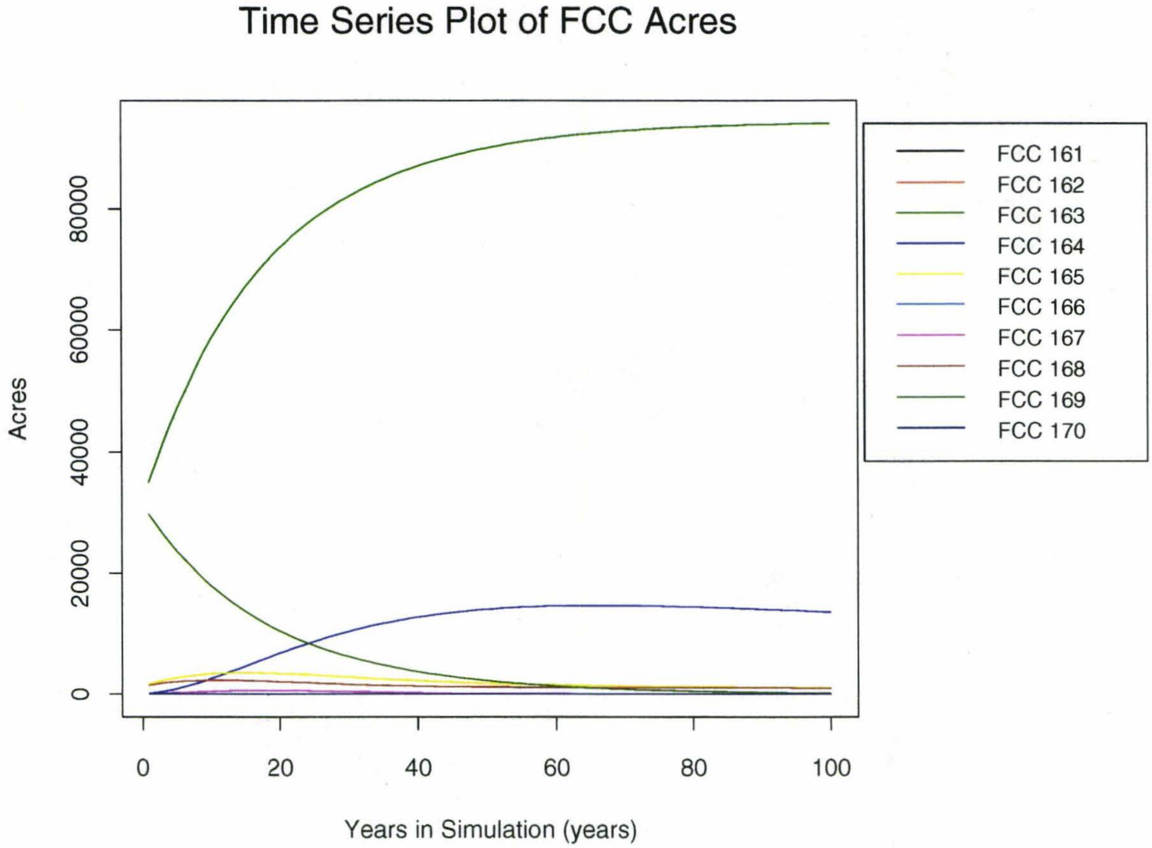


Figure C-1q
Distribution of Acres in Fuel Condition Classes 161-170 Over 100-Year Simulation, Base Scenario

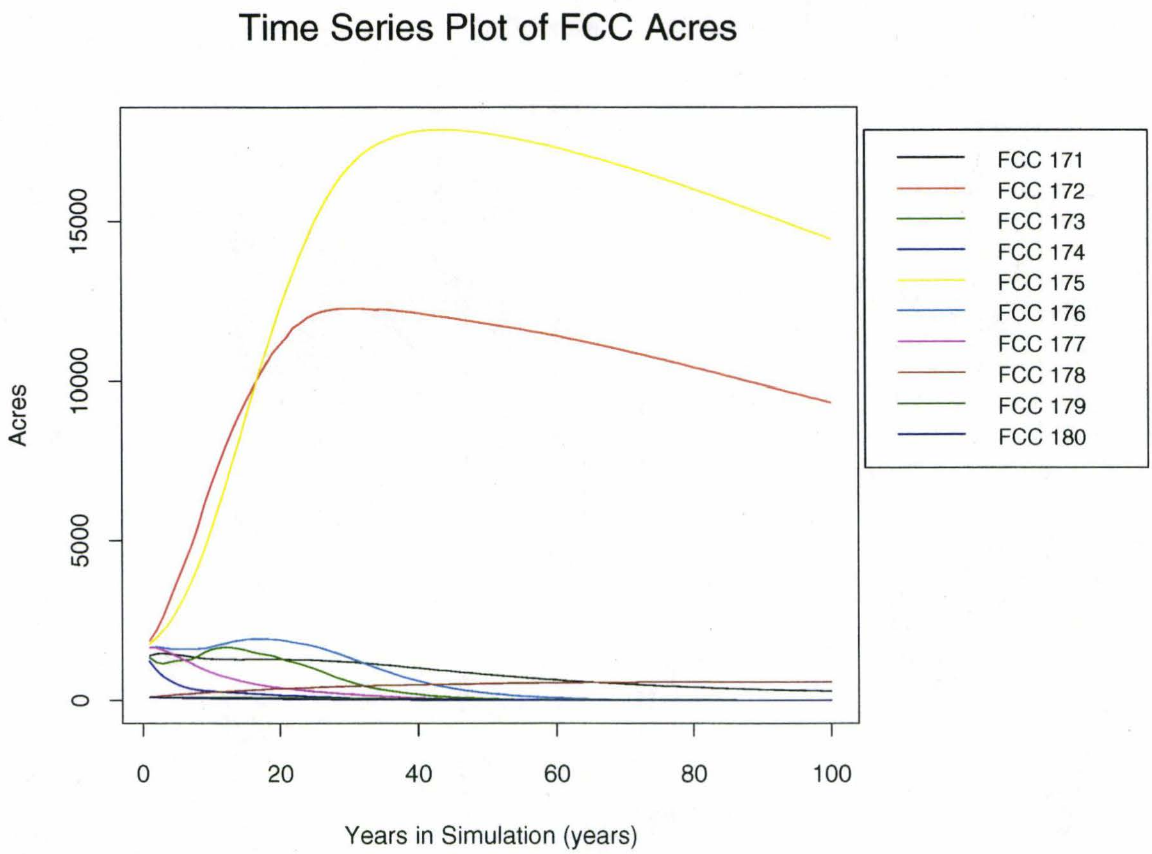


Figure C-1r
Distribution of Acres in Fuel Condition Classes 171-180 Over 100-Year Simulation, Base Scenario

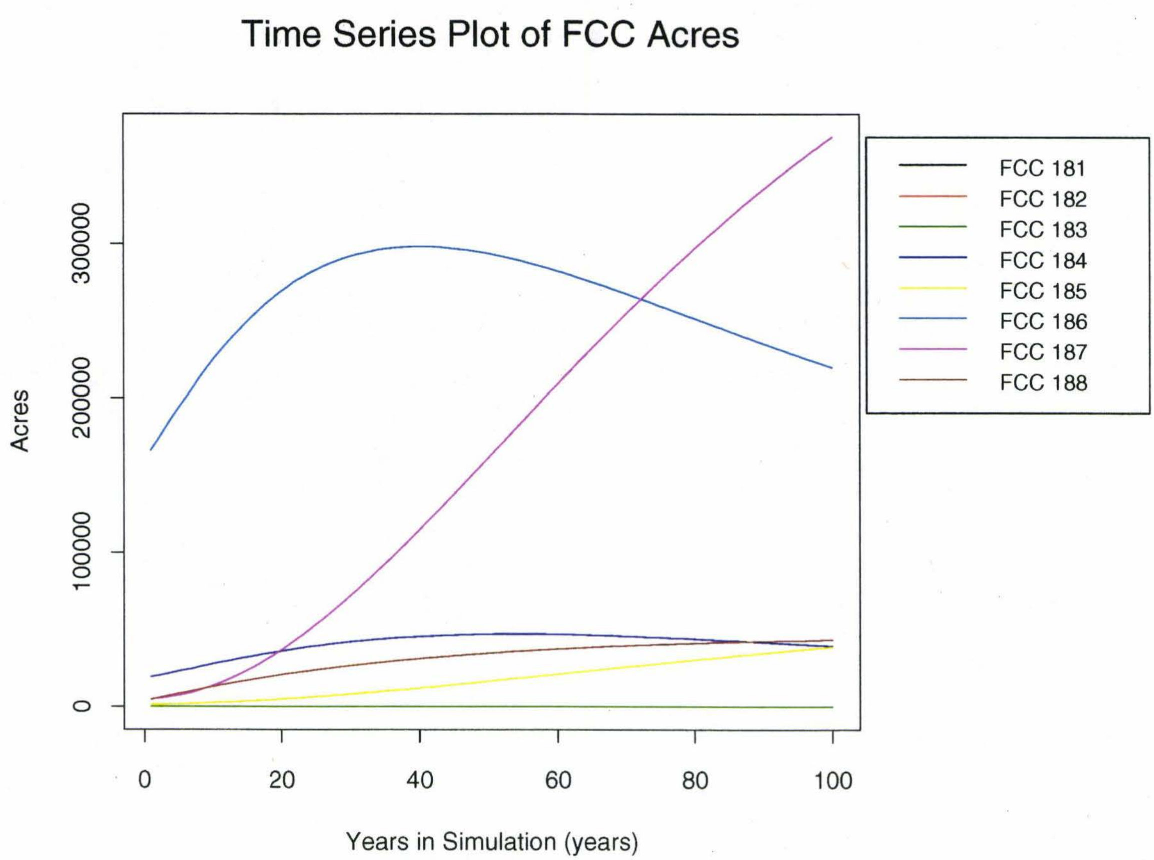


Figure C-1s
Distribution of Acres in Fuel Condition Classes 181-188 Over 100-Year Simulation, Base Scenario

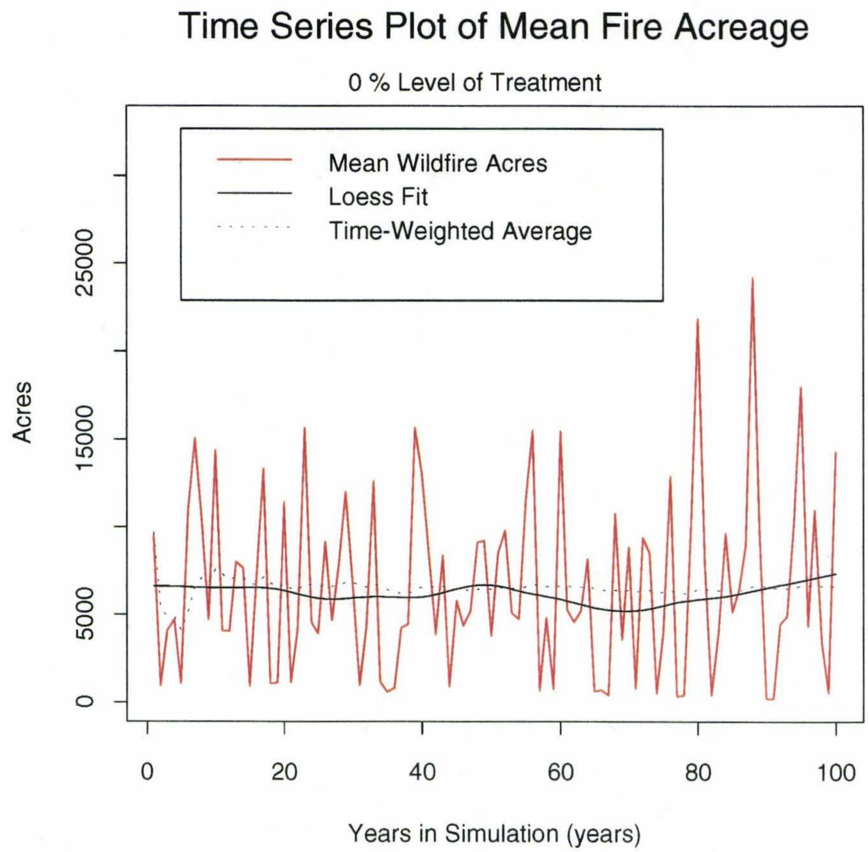


Figure C-2
FETM-Projected Wildfire Acreage within Grand Ronde River Basin Study Area, 0% Level of Prescribed Fire Treatment, Base Scenario

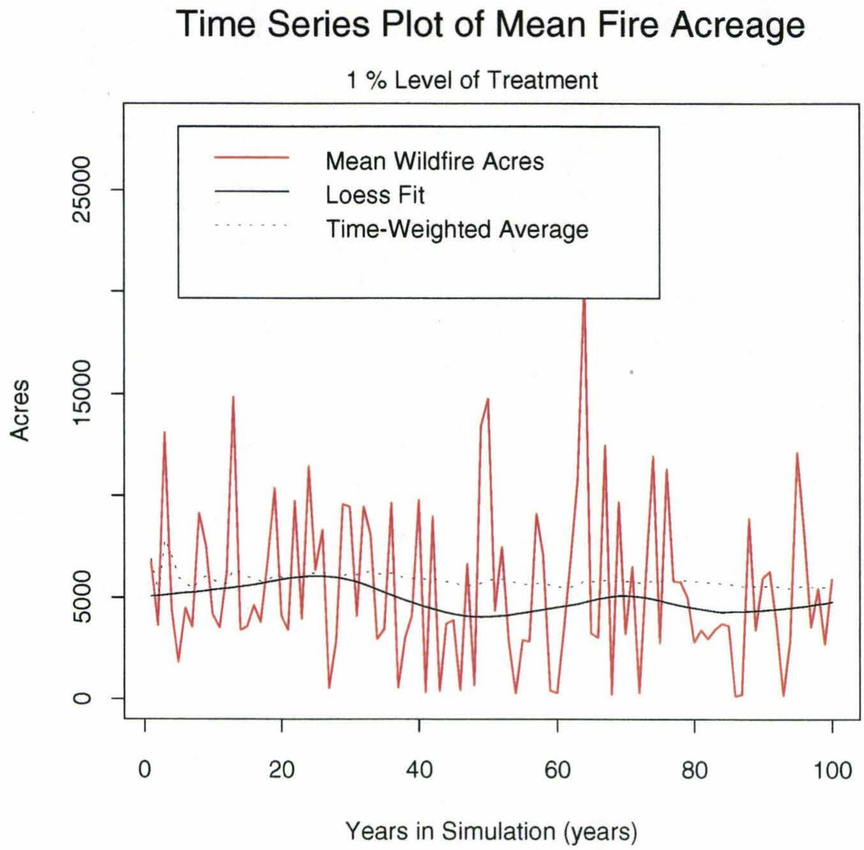


Figure C-3
FETM-Projected Wildfire Acreage within Grand Ronde River Basin Study Area, 1% Level of Prescribed Fire Treatment, Base Scenario

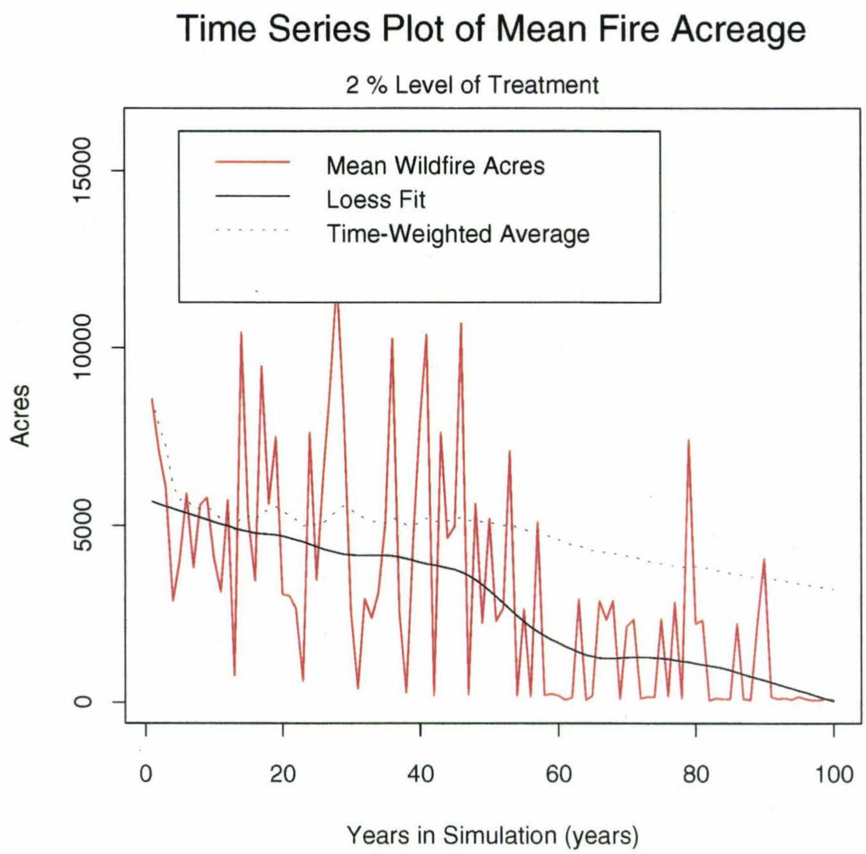


Figure C-4
FETM-Projected Wildfire Acreage within Grand Ronde River Basin Study Area, 2% Level of Prescribed Fire Treatment, Base Scenario

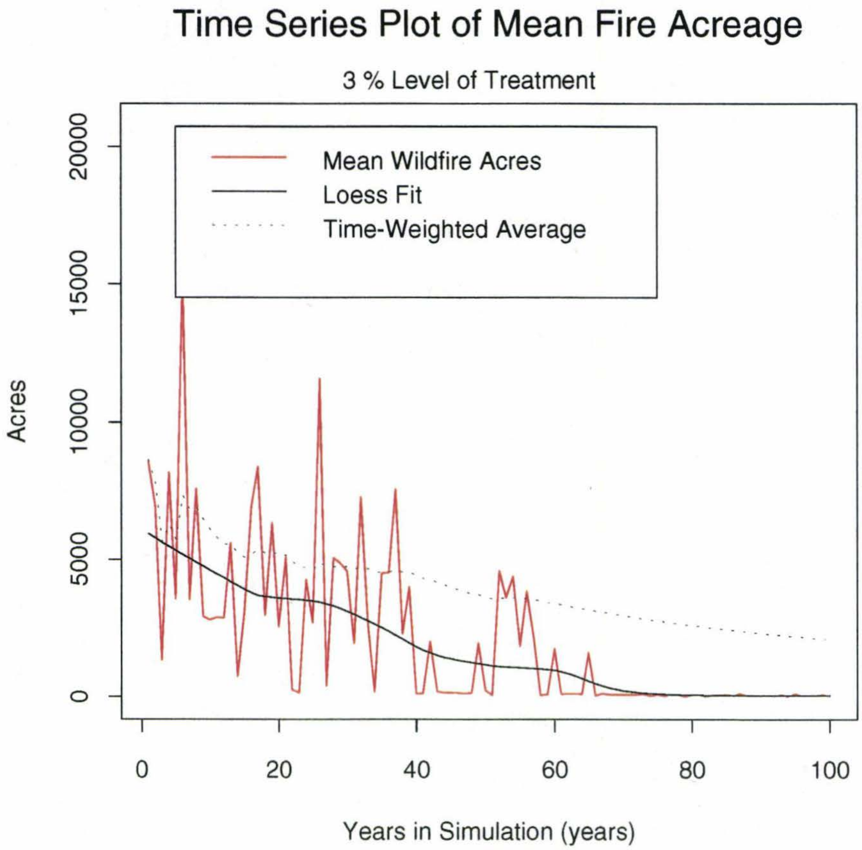


Figure C-5
FETM-Projected Wildfire Acreage within Grand Ronde River Basin Study Area, 3% Level of Prescribed Fire Treatment, Base Scenario

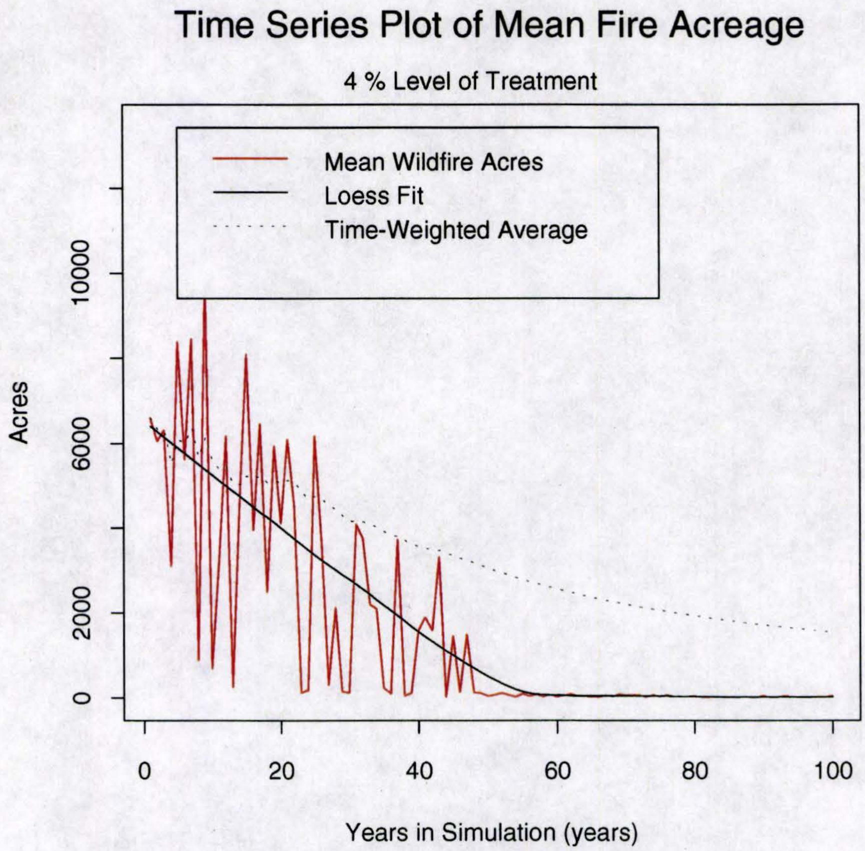


Figure C-6
FETM-Projected Wildfire Acreage within Grand Ronde River Basin Study Area, 4% Level of Prescribed Fire Treatment, Base Scenario

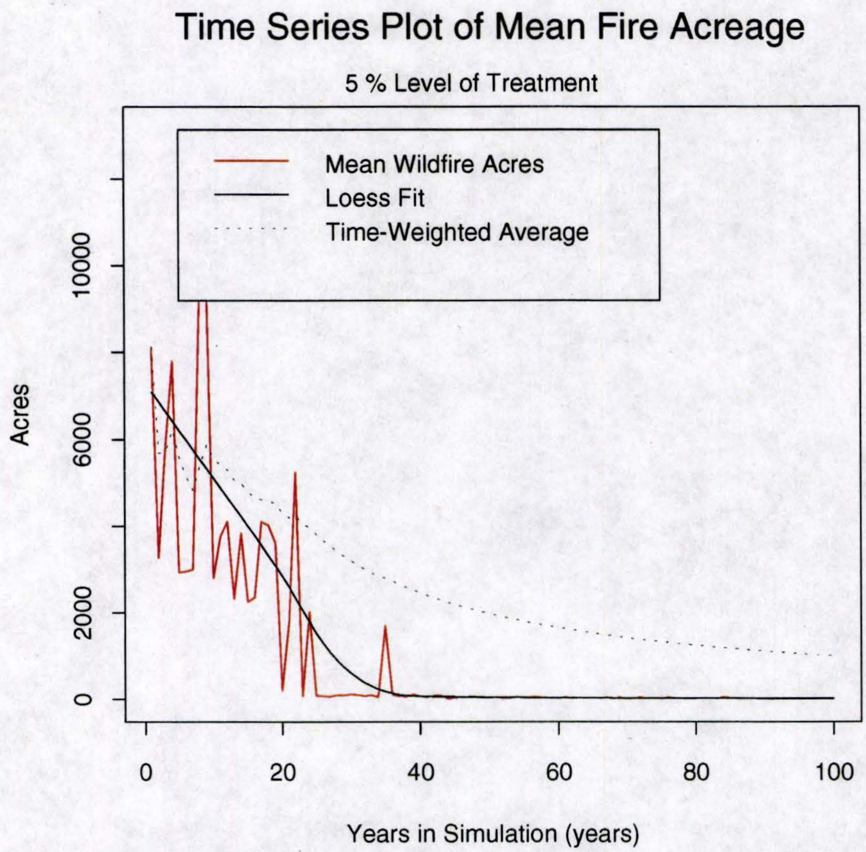


Figure C-7
FETM-Projected Wildfire Acreage within Grand Ronde River Basin Study Area, 5% Level of Prescribed Fire Treatment, Base Scenario

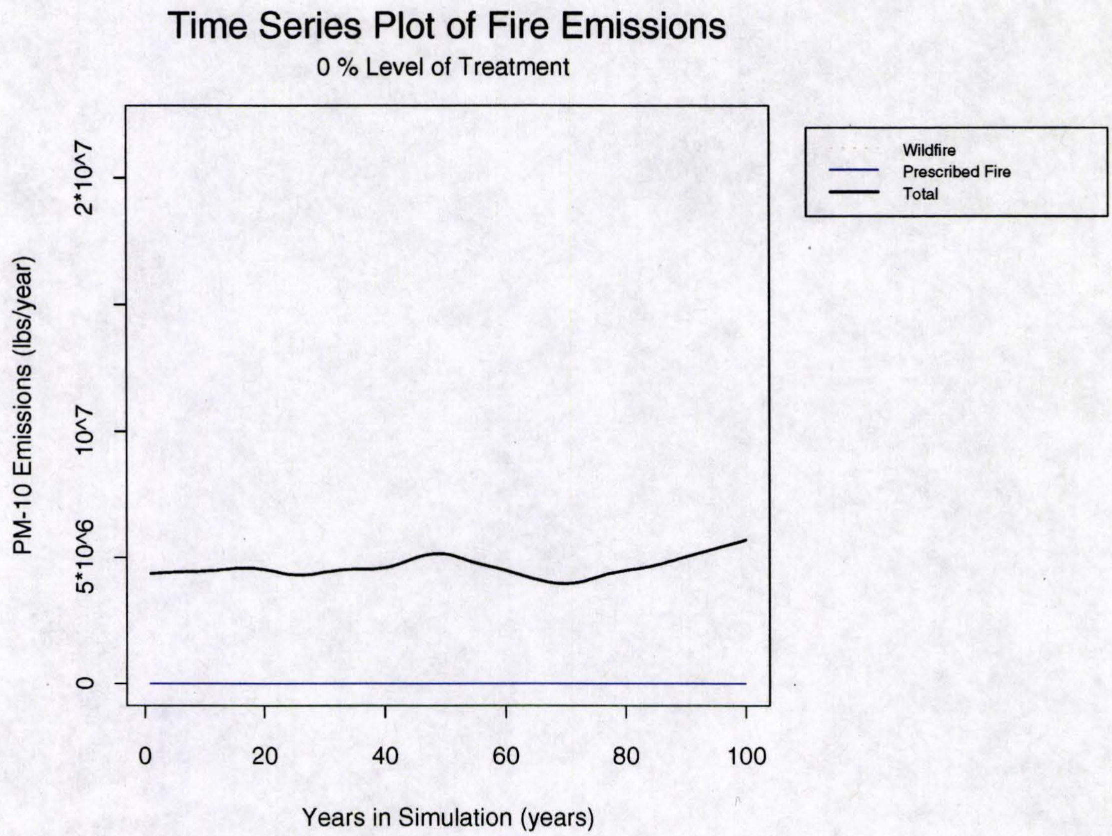


Figure C-8
Fire Emissions Over 100-Year Simulation Period, Average of 30 Iterations, Smoothed, 0% Level of Prescribed Fire Treatment, Base Scenario

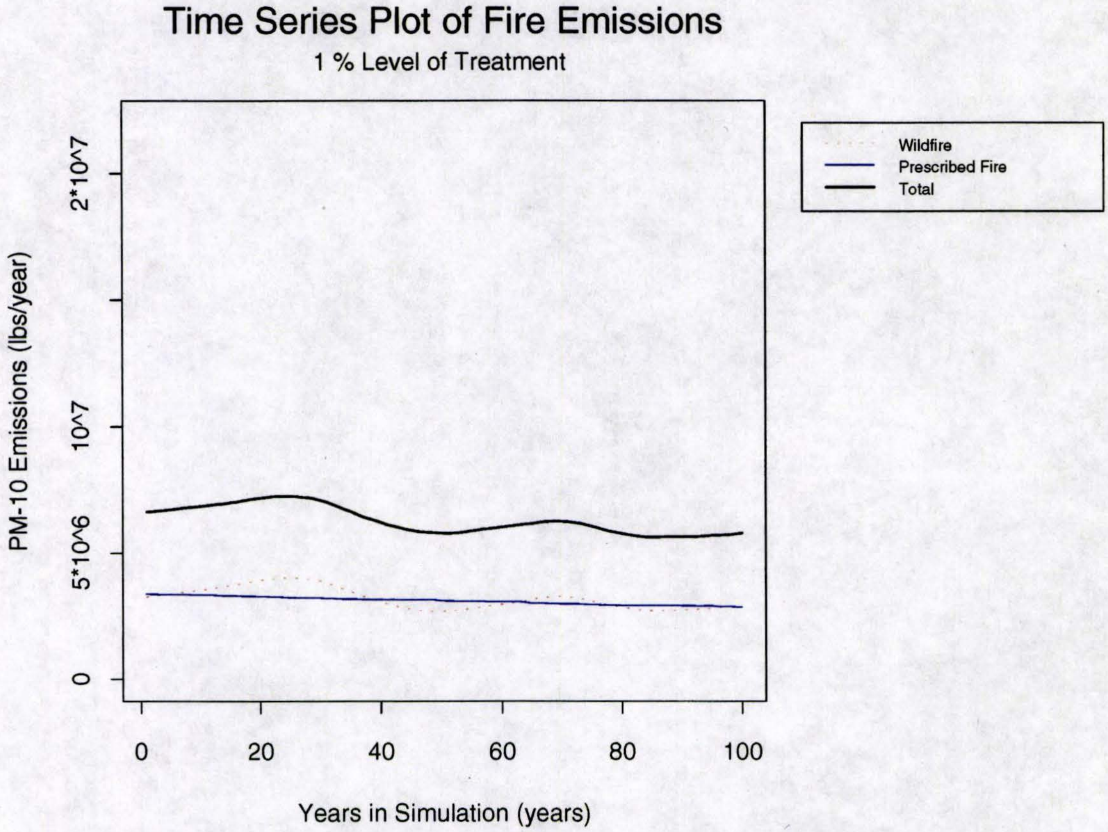


Figure C-9
Fire Emissions Over 100-Year Simulation Period, Average of 30 Iterations, Smoothed, 1% Level of Prescribed Fire Treatment, Base Scenario

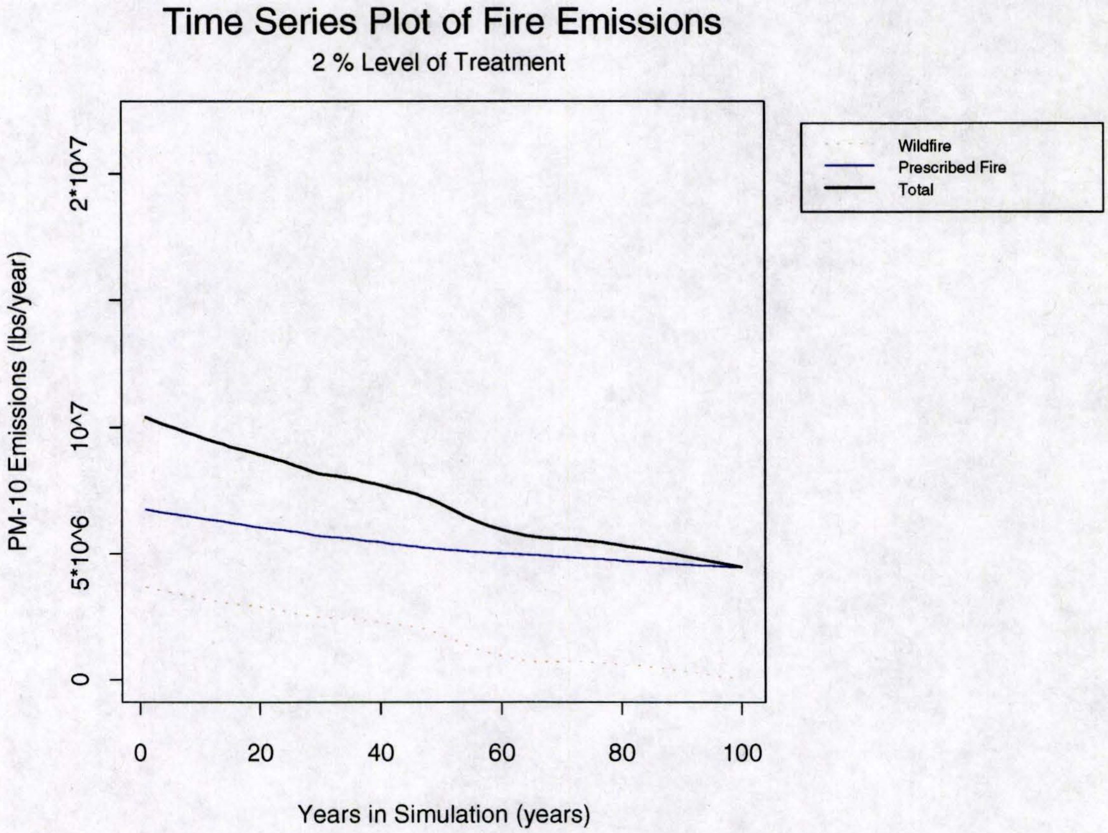


Figure C-10
Fire Emissions Over 100-Year Simulation Period, Average of 30 Iterations, Smoothed, 2% Level of Prescribed Fire Treatment, Base Scenario

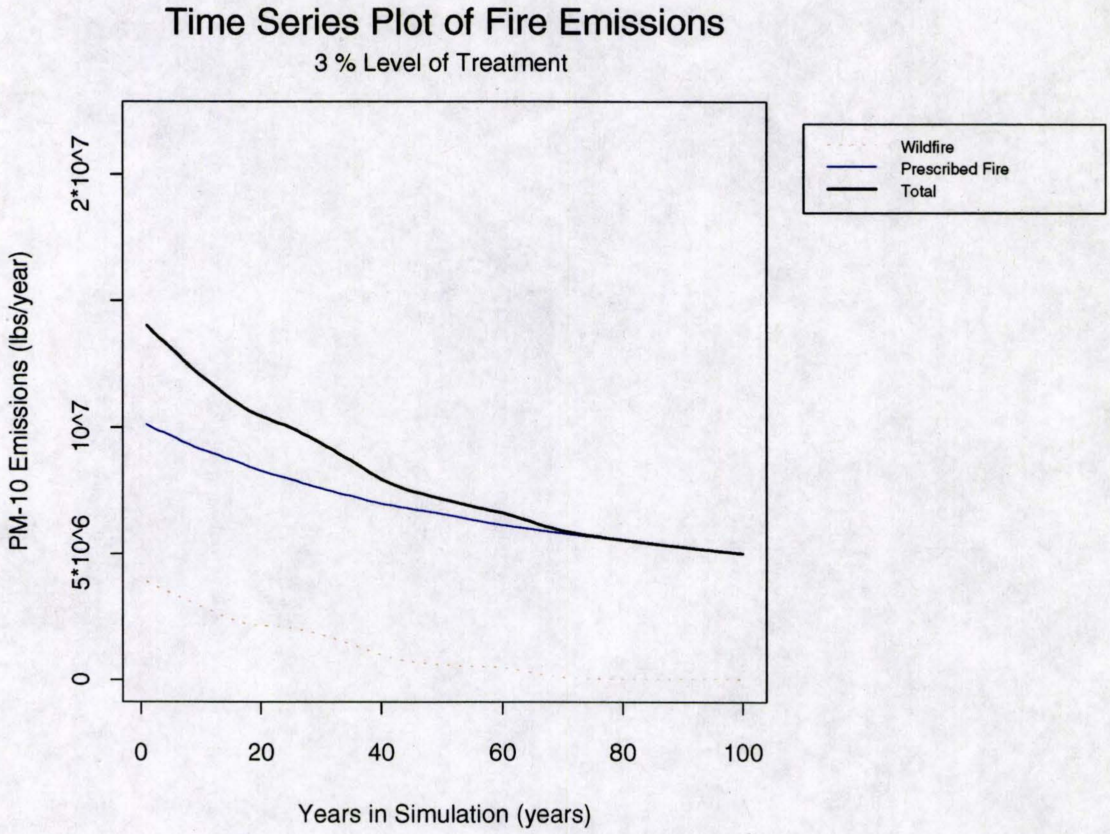


Figure C-11
Fire Emissions Over 100-Year Simulation Period, Average of 30 Iterations, Smoothed, 3% Level of Prescribed Fire Treatment, Base Scenario

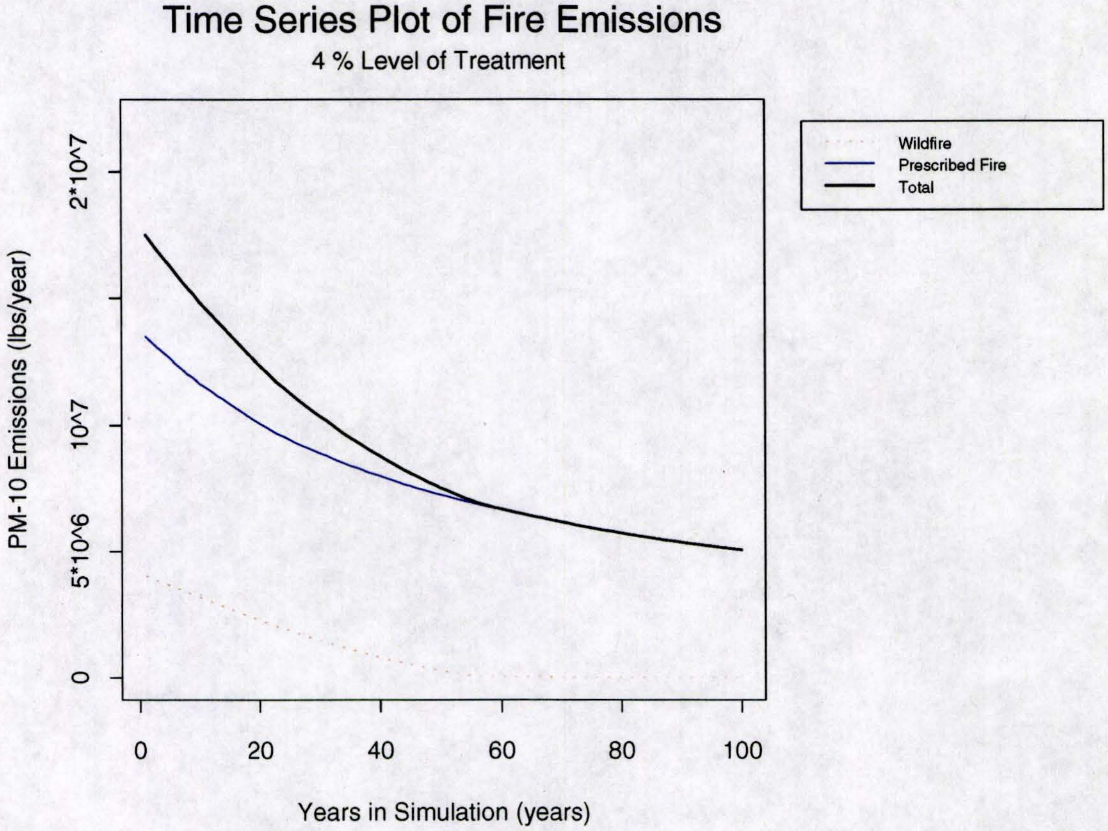


Figure C-12
Fire Emissions Over 100-Year Simulation Period, Average of 30 Iterations, Smoothed, 4% Level of Prescribed Fire Treatment, Base Scenario

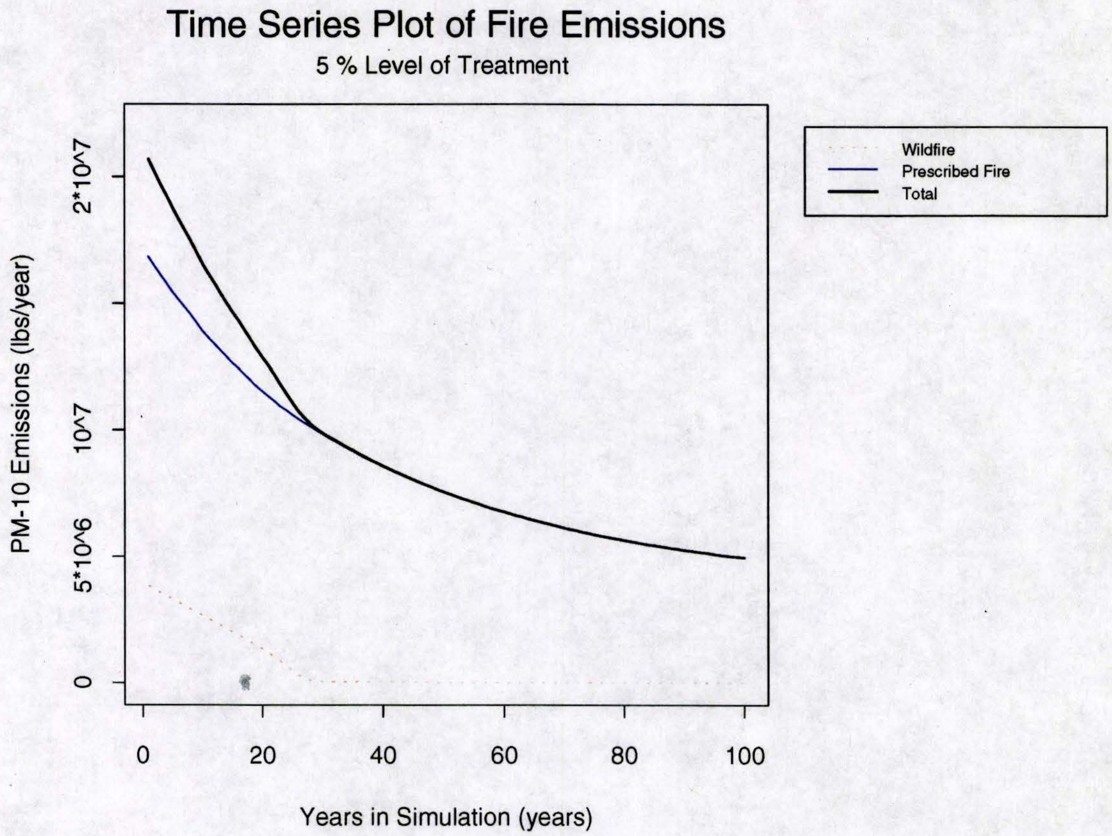


Figure C-13
Fire Emissions Over 100-Year Simulation Period, Average of 30 Iterations, Smoothed, 5% Level of Prescribed Fire Treatment, Base Scenario

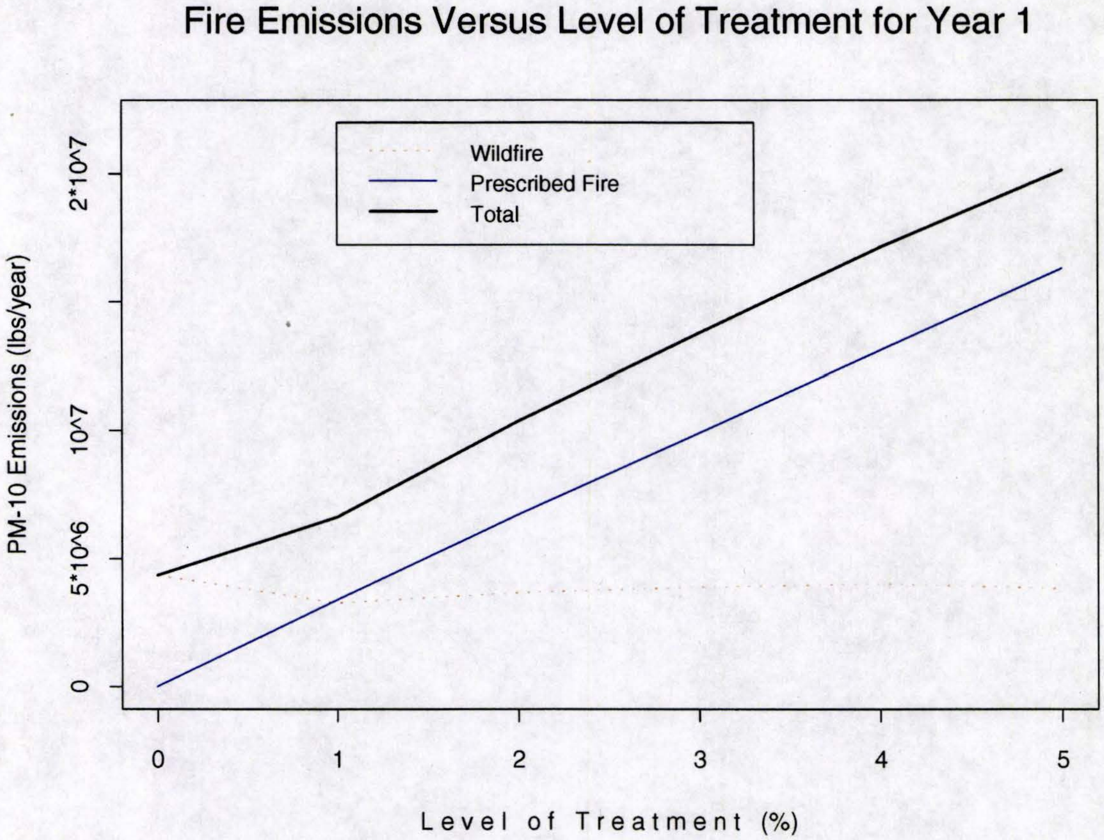


Figure C-14
Variation in Fire Emissions with Level of Prescribed Fire Treatment, Year 1 in Simulation, Base Scenario

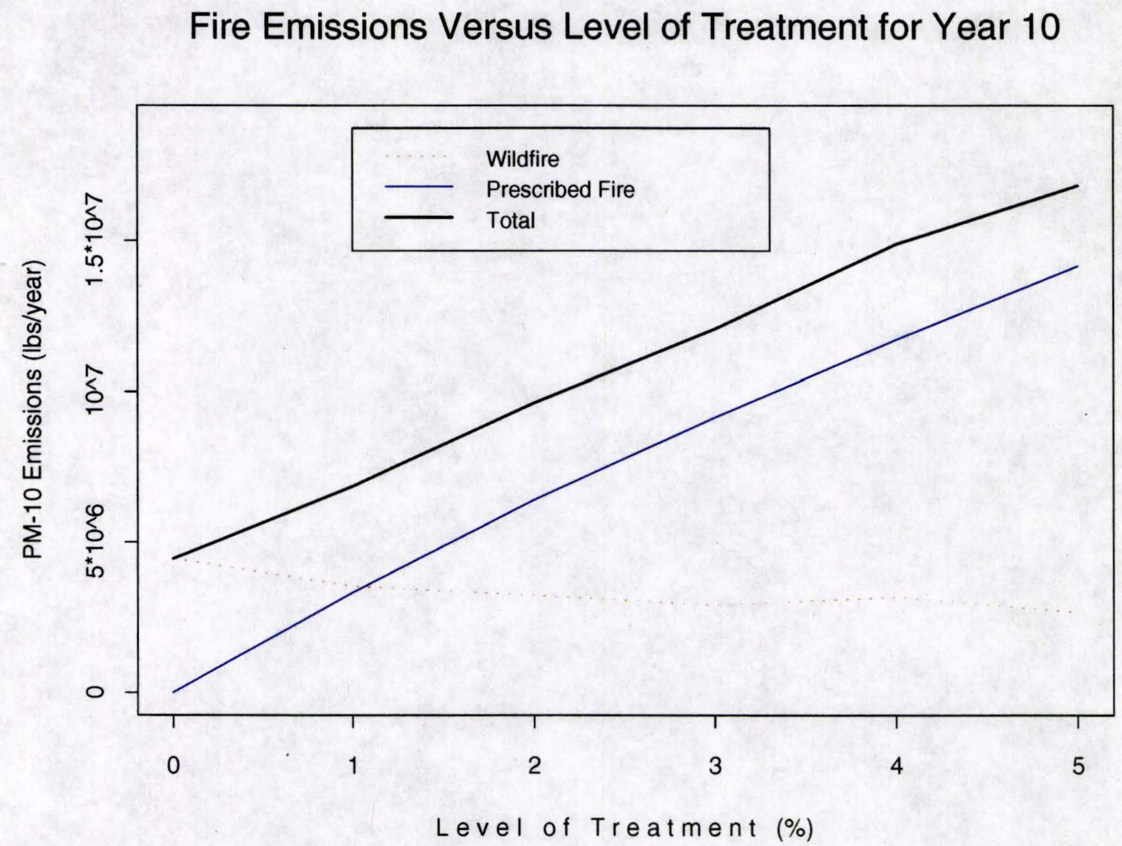


Figure C-15
Variation of Fire Emissions with Level of Prescribed Fire Treatment, Year 10 in Simulation, Base Scenario

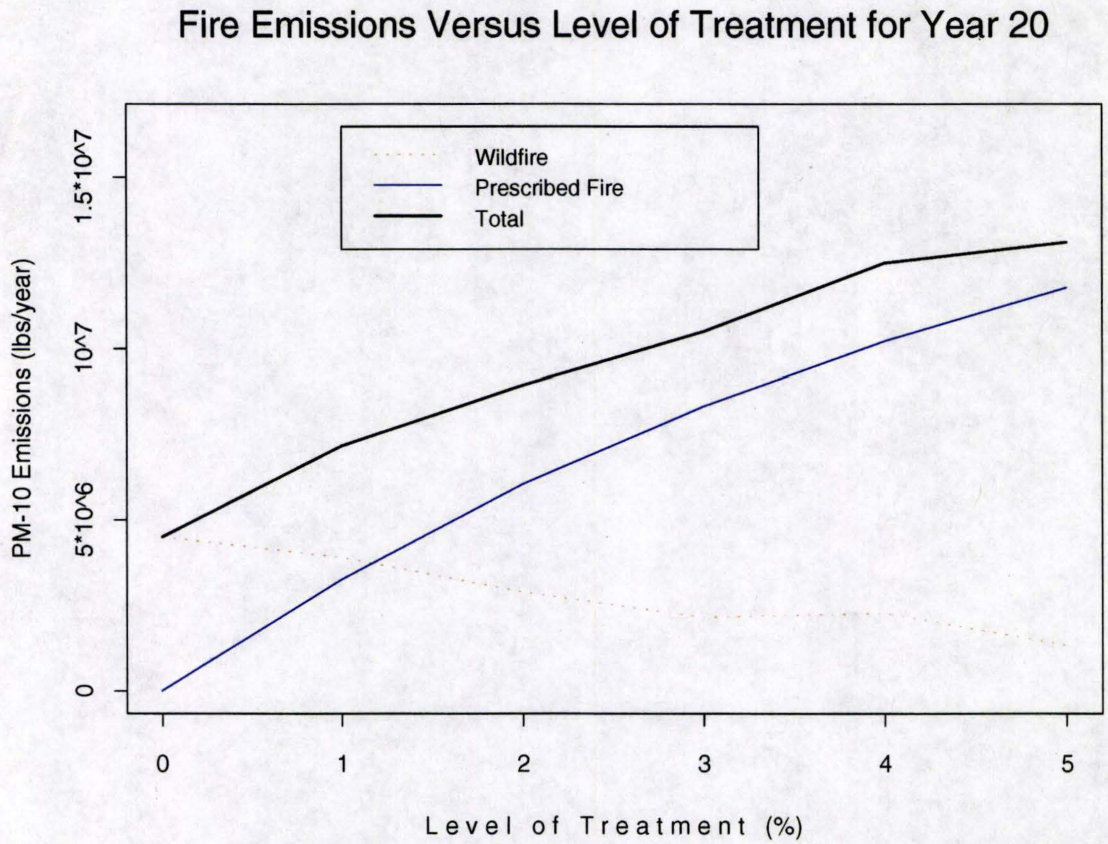


Figure C-16
Variation of Fire Emissions with Level of Prescribed Fire Treatment, Year 20 in Simulation, Base Scenario

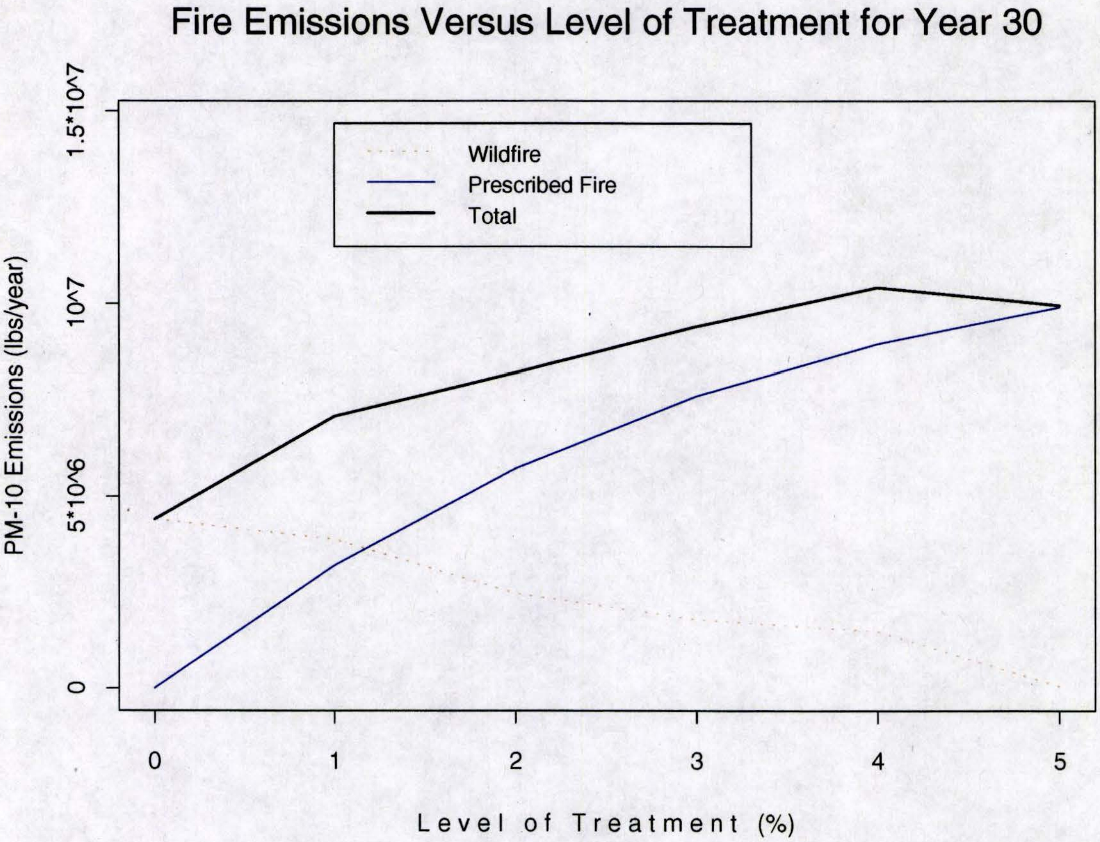


Figure C-17
Fire Emissions Versus Level of Prescribed Fire Treatment, Year 30 in Simulation, Base Scenario

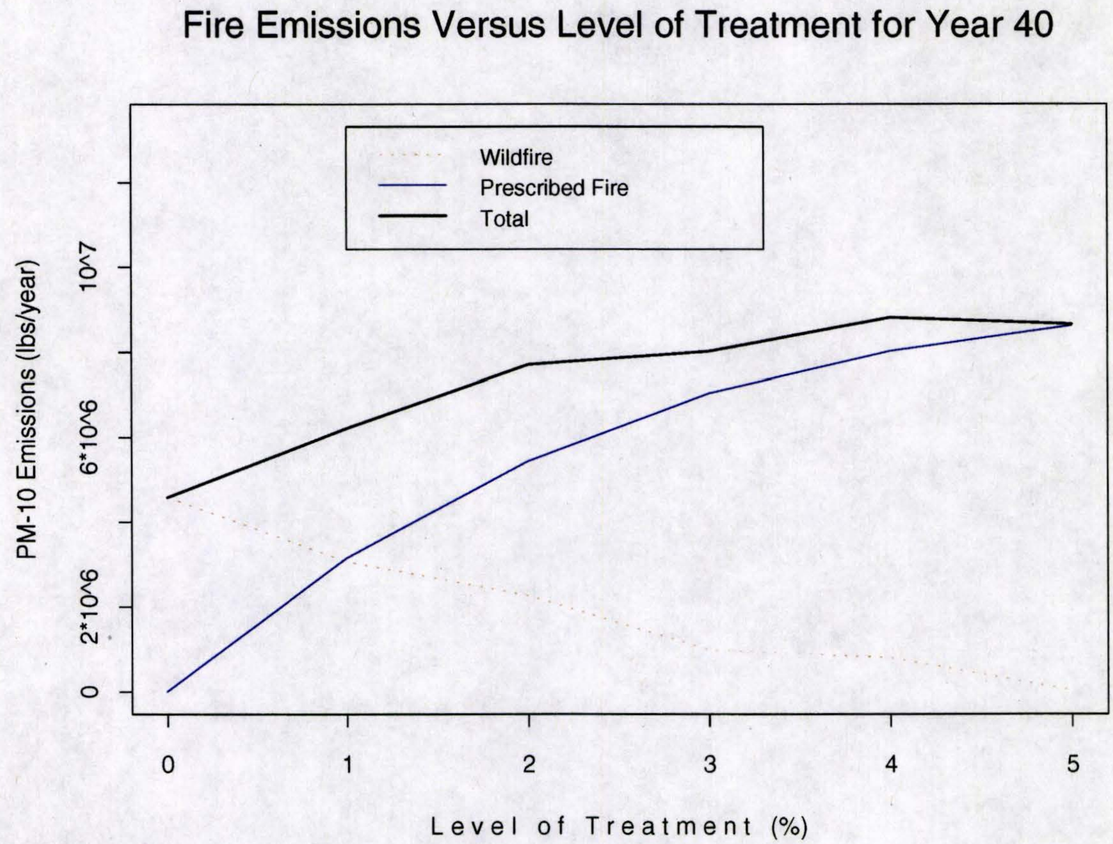


Figure C-18
Variation in Fire Emissions with Level of Prescribed Fire Treatment, Year 40 in Simulation, Base Scenario

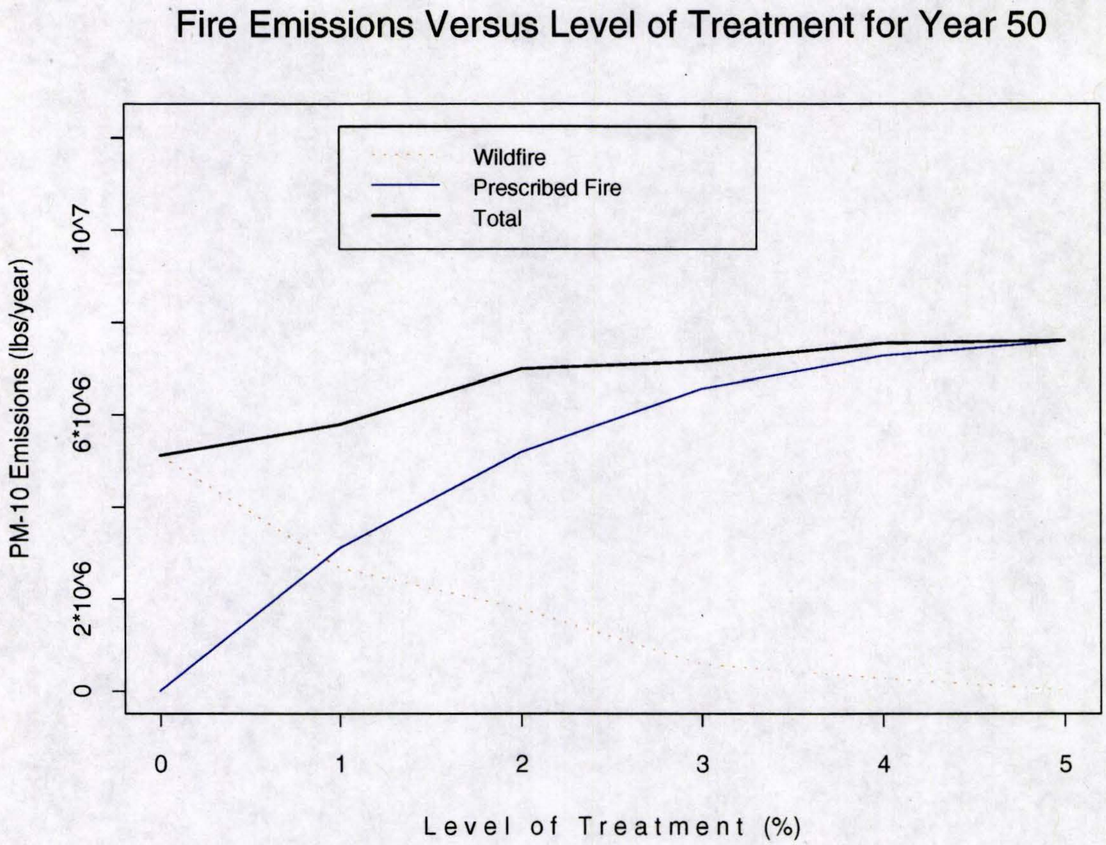


Figure C-19
Variation in Fire Emissions with Level of Prescribed Fire Treatment, Year 50 in Simulation, Base Scenario

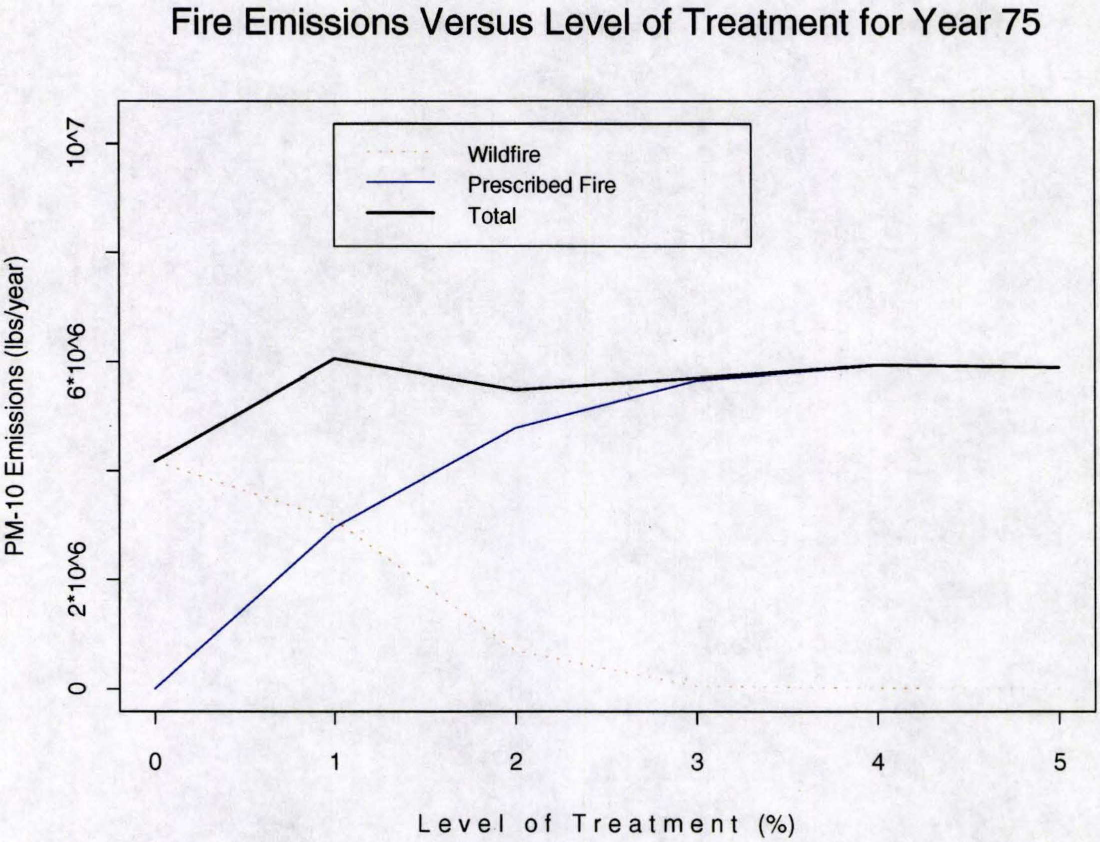


Figure C-20
Variation in Fire Emissions with Level of Prescribed Fire Treatment, Year 75 in Simulation, Base Scenario

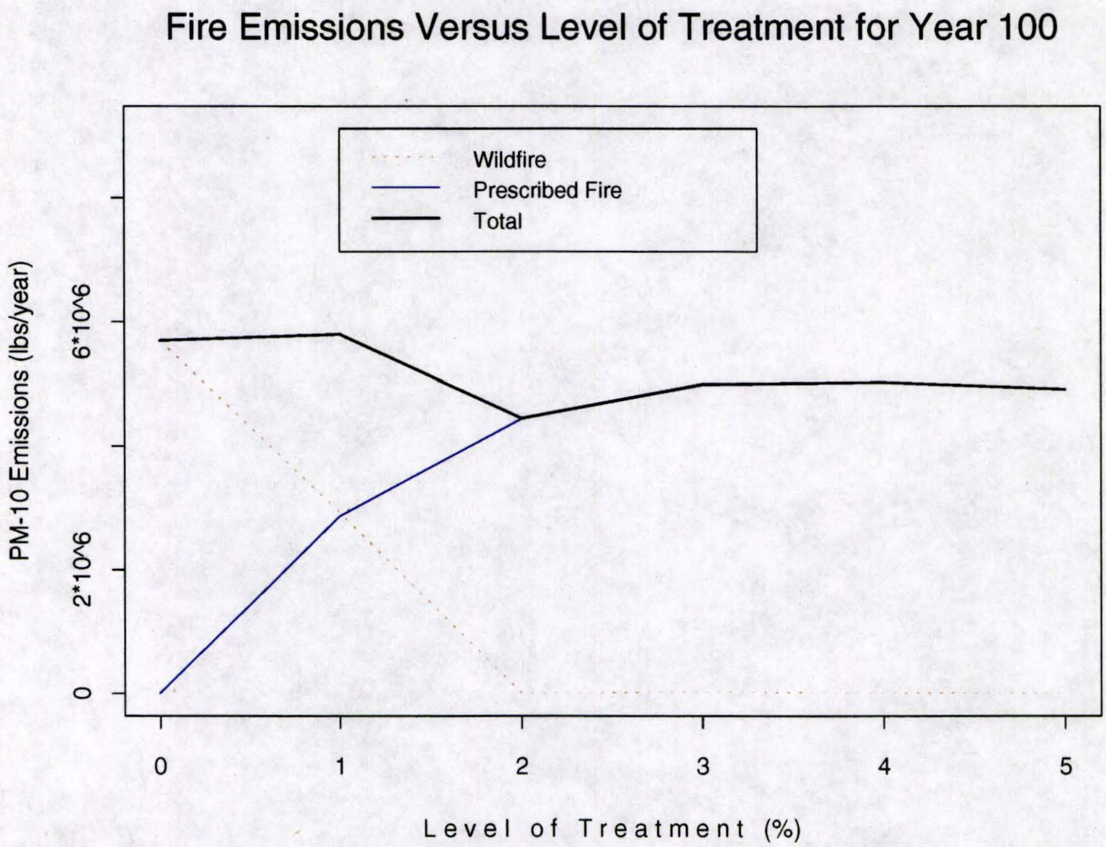
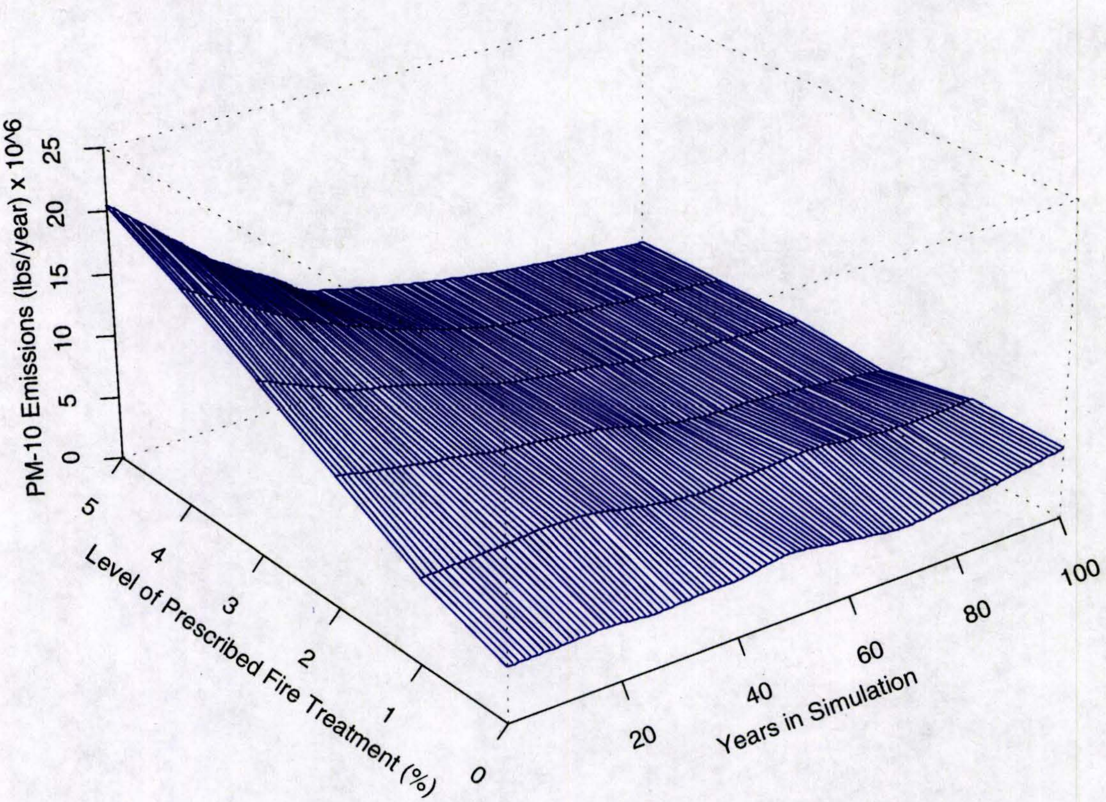


Figure C-21
Variation in Fire Emissions with Level of Prescribed Fire Treatment, Year 100 in Simulation, Base Scenario



SURFACE PLOT OF TOTAL FIRE EMISSIONS

Figure C-22
Surface Plot of Total Fire Emissions, Base Scenario

Appendix D
Miscellaneous Data Related to Fire Size Calculations

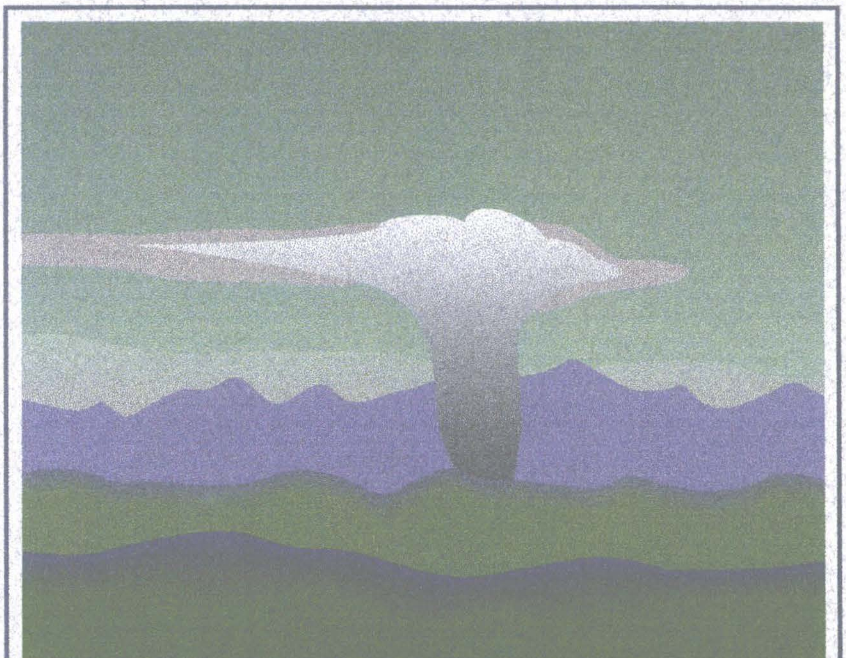


TABLE D-1
CALCULATION OF FIRE SIZE BY FCC AND FIRE WEATHER CLASS
FETM DEVELOPMENT
OPE70167.6C.A0 MDS JUNE 7, 1994
REVISED DECEMBER 22, 1994
(Ratios of Crown/Ground ROS Added 11/20/94)

FCC	Carlton Mod ID	Veg Type	Age Class	Loading Class	Activity Class	Deeming's Extended NFDRS Fuel Models	Fuel Flag	See Carlton's 10/10/94 Notes (Extreme Only) Crown/Ground SC or ROS Ratio	Spread Component (feet/min) from PCFIRDAT: Extreme	Spread Component: V. High	Spread Component: High	Rate of Spread (chains/hour) Note: ROS = SC * 0.9091: Extreme	Rate of Spread: V. High	Rate of Spread: High	From Carlton's pcFIRDAT Passing Files, 8/14/94 Energy Release Component from PCFIRDAT: Extreme	Energy Release Component: V. High	Energy Release Component: High	From "CRIT-SC.XLS" Critical SC for Crown Fires (feet/min)	Critical ERC for Crown Fires (feet/min)	Height to Base of Ladder Fuels (feet)	Total Tree Density (tpa)	Based on SC, ERC, and TPA Crown Fire Possible?: Extreme	Crown Fire Possible?: V. High	Crown Fire Possible?: High	Final Fire Size (Acres) With Crowning: Extreme	Final Fire Size: V. High	Final Fire Size: High
1	HL3	PP	Bare	L		HL / 0.4 / Unsh.	1	13.3	4.0	3.0	1.0	3.6	2.7	0.9	31	25	16	999	999	-	0	No	No	No	2.0	1.6	1.1
2	HM2	PP	Bare	M		HM / 0.3 / Unsh.	1	13.3	4.0	3.0	1.0	3.6	2.7	0.9	47	37	24	999	999	-	0	No	No	No	2.0	1.6	1.1
3	HL3	PP	Bare	H		HL / 0.4 / Unsh.	1	13.3	4.0	3.0	1.0	3.6	2.7	0.9	31	25	16	999	999	-	0	No	No	No	2.0	1.6	1.1
4	UM1	PP	Imm	L		UM / 0.2 / Sh.	1	8.1	4.5	3.0	1.7	4.1	2.7	1.5	50	37	26	10	60	9	1369	No	No	No	2.2	1.6	1.3
5	CM1	PP	Imm	M		CM / 0.2 / Sh.	3	4	9.8	6.0	3.4	8.9	5.5	3.1	22	14	8	20	28	9	1369	No	No	No	3.6	2.3	1.6
6	CH1	PP	Imm	H		CH / 0.2 / Sh.	3	3.1	12.8	7.5	5.1	11.6	6.8	4.6	29	19	11	19	30	9	1369	No	No	No	5.3	2.7	2.0
7	UL1	PP	Mat	L		UL / 0.2 / Sh.	1	12.2	3.0	2.3	1.7	2.7	2.0	1.5	31	25	18	10	50	8	297	No	No	No	1.6	1.4	1.3
8	UM1	PP	Mat	M		UM / 0.2 / Sh.	1	8.1	4.5	3.0	1.7	4.1	2.7	1.5	50	37	26	8	56	8	297	No	No	No	2.2	1.6	1.3
9	HM1	PP	Mat	H		HM / 0.2 / Sh.	1	13	2.3	1.5	0.9	2.0	1.4	0.8	47	37	24	5	87	8	297	No	No	No	1.4	1.2	1.1
10	TM1	PP	Over	L		TM / 0.2 / Sh.	4	1.7	13.5	8.3	4.3	12.3	7.5	3.9	21	13	4	16	19	6	836	YES	No	No	83.0	5.8	2.6
11	HM1	PP	Over	M		HM / 0.2 / Sh.	1	13	2.3	1.5	0.9	2.0	1.4	0.8	47	37	24	4	72	6	836	No	No	No	1.4	1.2	1.1
12	UL1	PP	Over	H		UL / 0.2 / Sh.	1	12.2	3.0	2.3	1.7	2.7	2.0	1.5	31	25	18	7	44	6	836	No	No	No	1.6	1.4	1.3
13	P	PP	Imm	L	PCT/Pile	Piled	5	1	1.0	1.0	1.0	0.9	0.9	0.9	0	0	0	999	999	9	175	No	No	No	0.0	0.0	0.0
14	KL1	PP	Imm	L	PCT/L&S	KLC / 0.2 / Sh.	2	15	2.3	1.5	0.9	2.0	1.4	0.8	56	48	36	8	73	9	175	No	No	No	2.8	2.2	1.7
15	KL2	PP	Imm	L	PCT or CT/NMT	KL / 0.2 / Sh.	2	10.4	4.5	2.3	1.7	4.1	2.0	1.5	53	44	34	9	65	9	175	No	No	No	5.5	2.8	2.3
16	P	PP	Imm	L	CT/Pile	Piled	5	1	1.0	1.0	1.0	0.9	0.9	0.9	0	0	0	999	999	9	175	No	No	No	0.0	0.0	0.0
17	KL1	PP	Imm	L	CT/L&S	KLC / 0.2 / Sh.	2	15	2.3	1.5	0.9	2.0	1.4	0.8	56	48	36	8	73	9	175	No	No	No	2.8	2.2	1.7
18	P	PP	Imm	M	PCT/Pile	Piled	5	1	1.0	1.0	1.0	0.9	0.9	0.9	0	0	0	999	999	9	175	No	No	No	0.0	0.0	0.0
19	JL1	PP	Imm	M	PCT/L&S	JLC / 0.2 / Sh.	2	7.8	6.0	3.8	2.6	5.5	3.4	2.3	181	150	115	5	127	9	175	YES	YES	No	11,666.8	777.9	3.1
20	JL3	PP	Imm	M	PCT or CT/NMT	JL / 0.2 / Sh.	2	4.7	9.8	6.8	5.1	8.9	6.1	4.6	191	160	123	5	106	9	175	YES	YES	YES	10,121.5	1,165.7	317.5
21	P	PP	Imm	M	CT/Pile	Piled	5	1	1.0	1.0	1.0	0.9	0.9	0.9	0	0	0	999	999	9	175	No	No	No	0.0	0.0	0.0
22	JL1	PP	Imm	M	CT/L&S	JLC / 0.2 / Sh.	2	7.8	6.0	3.8	2.6	5.5	3.4	2.3	181	150	115	5	127	9	175	YES	YES	No	11,666.8	777.9	3.1
23	P	PP	Imm	H	PCT/Pile	Piled	5	1	1.0	1.0	1.0	0.9	0.9	0.9	0	0	0	999	999	9	175	No	No	No	0.0	0.0	0.0
24	JL1	PP	Imm	H	PCT/L&S	JLC / 0.2 / Sh.	2	7.8	6.0	3.8	2.6	5.5	3.4	2.3	181	150	115	5	127	9	175	YES	YES	No	11,666.8	777.9	3.1
25	JL3	PP	Imm	H	PCT or CT/NMT	JL / 0.2 / Sh.	2	4.7	9.8	6.8	5.1	8.9	6.1	4.6	191	160	123	5	106	9	175	YES	YES	YES	10,121.5	1,165.7	317.5
26	P	PP	Imm	H	CT/Pile	Piled	5	1	1.0	1.0	1.0	0.9	0.9	0.9	0	0	0	999	999	9	175	No	No	No	0.0	0.0	0.0
27	JL1	PP	Imm	H	CT/L&S	JLC / 0.2 / Sh.	2	7.8	6.0	3.8	2.6	5.5	3.4	2.3	181	150	115	5	127	9	175	YES	YES	No	11,666.8	777.9	3.1
28	KM5	PP	Mat	L	Logged	KM / 0.3 / Unsh.	2	5.6	13.0	8.0	5.0	11.8	7.3	4.5	84	71	54	8	62	8	150	YES	YES	No	30,000.0	8,709.3	6.3
29	KM5	PP	Mat	L	Logged/NMT	KM / 0.3 / Unsh.	2	5.6	13.0	8.0	5.0	11.8	7.3	4.5	84	71	54	8	62	8	150	YES	YES	No	30,000.0	8,709.3	6.3
30	KL3	PP	Mat	L	Logged/Crush	KLC / 0.3 / Unsh.	2	8.9	6.0	3.0	2.0	5.5	2.7	1.8	56	48	36	10	49	8	150	YES	No	No	29,913.4	3.6	2.6
31	KM4	PP	Mat	L	Logged/YUM	KM / 0.2 / Sh.	2	8.1	6.8	4.5	3.4	6.1	4.1	3.1	84	71	54	7	72	8	150	YES	No	No	30,000.0	5.5	4.0
32	KM5	PP	Mat	M	Logged	KM / 0.3 / Unsh.	2	5.6	13.0	8.0	5.0	11.8	7.3	4.5	84	71	54	8	62	8	150	YES	YES	No	30,000.0	8,709.3	6.3
33	KM5	PP	Mat	M	Logged/NMT	KM / 0.3 / Unsh.	2	5.6	13.0	8.0	5.0	11.8	7.3	4.5	84	71	54	8	62	8	150	YES	YES	No	30,000.0	8,709.3	6.3
34	KL3	PP	Mat	M	Logged/Crush	KLC / 0.3 / Unsh.	2	8.9	6.0	3.0	2.0	5.5	2.7	1.8	56	48	36	10	49	8	150	YES	No	No	29,913.4	3.6	2.6
35	KM5	PP	Mat	M	Logged/YUM	KM / 0.3 / Unsh.	2	5.6	13.0	8.0	5.0	11.8	7.3	4.5	84	71	54	8	62	8	150	YES	YES	No	30,000.0	8,709.3	6.3
36	JL4	PP	Mat	H	Logged	JL / 0.3 / Unsh.	2	3.3	20.0	12.0	7.0	18.2	10.9	6.4	191	160	123	5	91	8	150	YES	YES	YES	30,000.0	4,002.4	272.6
37	JL4	PP	Mat	H	Logged/NMT	JL / 0.3 / Unsh.	2	3.3	20.0	12.0	7.0	18.2	10.9	6.4	191	160	123	5	91	8	150	YES	YES	YES	30,000.0	4,002.4	272.6
38	JL2	PP	Mat	H	Logged/Crush	JLC / 0.3 / Unsh.	2	6.7	11.0	7.0	4.0	10.0	6.4	3.6	181	150	115	5	106	8	150	YES	YES	YES	30,000.0	11,837.5	516.4
39	KM5	PP	Mat	H	Logged/YUM	KM / 0.3 / Unsh.	2	5.6	13.0	8.0	5.0	11.8	7.3	4.5	84	71	54	8	62	8	150	YES	YES	No	30,000.0	8,709.3	6.3
40	KM5	PP	Over	L	Logged	KM / 0.3 / Unsh.	2	5.6	13.0	8.0	5.0	11.8	7.3	4.5	84	71	54	999	999	6	75	No	No	No	40.2	13.4	6.3
41	KM5	PP	Over	L	Logged/NMT	KM / 0.3 / Unsh.	2	5.6	13.0	8.0	5.0	11.8	7.3	4.5	84	71	54	999	999	6	75	No	No	No	40.2	13.4	6.3
42	KL3	PP	Over	L	Logged/Crush	KLC / 0.3 / Unsh.	2	8.9	6.0	3.0	2.0	5.5	2.7	1.8	56	48	36	7	45	6	75	YES	YES	No	29,913.4	507.7	2.6
43	KM5	PP	Over	L	Logged/YUM	KM / 0.3 / Unsh.	2	5.6	13.0	8.0	5.0	11.8	7.3	4.5	84	71	54	999	999	6	75	No	No	No	40.2	13.4	6.3
44	KM4	PP	Over	M	Logged	KM / 0.2 / Sh.	2	8.1	6.8	4.5	3.4	6.1	4.1	3.1	84	71	54	999	999	6	75	No	No	No	9.9	5.5	4.0
45	KM4	PP	Over	M	Logged/NMT	KM / 0.2 / Sh.	2	8.1	6.8	4.5	3.4	6.1	4.1	3.1	84	71	54	999	999	6	75	No	No	No	9.9	5.5	4.0
46	KL1	PP	Over	M	Logged/Crush	KLC / 0.2 / Sh.	2	15	2.3	1.5	0.9	2.0	1.4	0.8	56	48	36	5	63	6	75	No	No	No	2.8	2.2	1.7
47	KM4	PP	Over	M	Logged/YUM	KM / 0.2 / Unsh.	2	8.1	9.0	6.0	4.0	8.2	5.5	3.6	84	71	54	999	999	6	75	No	No	No	16.9	8.2	4.8
48	KM6	PP	Over	H	Logged	KM / 0.5 / Unsh.	2	4.2	23.0	13.0	7.0	20.9	11.8	6.4	84	71	54	999	999	6	75	No	No	No	267.8	40.2	10.6
49	KM6	PP	Over	H	Logged/NMT	KM / 0.5 / Unsh.	2	4.2	23.0	13.0	7.0	20.9	11.8	6.4	84	71	54	999	999	6	75	No	No	No	267.8	40.2	10.6
50	KL4	PP	Over	H	Logged/Crush	KLC / 0.5 / Unsh.	2	8.5	9.0	5.0	3.0	8.2	4.5	2.7	56	48	36	999	999	6	75	No	No	No	16.9	6.3	3.6
51	KH4	PP	Over	H	Logged/YUM	KH / 0.3 / Unsh.	2	4.1	17.0	11.0	6.0	15.5	10.0	5.5	113	96	73	999	999	6	75	No	No	No	89.0	26.4	8.2
52	HM1	MC	Bare	L		HM / 0.2 / Sh.	1	13	2.3	1.5	0.9	2.0	1.4	0.8	47	37	24	999	999	-	0	No	No	No	1.4	1.2	1.1
53	HM1	MC	Bare	M		HM / 0.2 / Sh.	1	13	2.3	1.5	0.9	2.0	1.4	0.8	47	37	24	999	999	-	0	No	No	No	1.4	1.2	1.1
54	HL1	MC	Bare	H		HL / 0.2 / Sh.	1	31.1	1.5	0.8	0.9	1.4	0.7	0.8	31	25	16	999	999	-	0	No	No	No	1.2	1.1	1.1
55	HM1	MC	Imm	L		HM / 0.2 / Sh.	1	13	2.3	1.5	0.9	2.0	1.4	0.8	47	37	24	9	129	15	1486	No	No	No	1.4	1.2	1.1
56	HM1	MC	Imm	M		HM / 0.2 / Sh.	1	13	2.3	1.5	0.9	2.0	1.4	0.8	47	37	24	9	129	15	1486	No	No	No	1.4	1.2	1.1
57	HL1	MC	Imm	H		HL / 0.2 / Sh.	1	31.1	1.5	0.8	0.9	1.4	0.7	0.8	31	25	16	7	175	15	1486	No	No	No	1.2	1.1	1.1
58	HL1	MC	Mat	L		HL / 0.2 / Sh.	1	31.1	1.5	0.8	0.9	1.4	0.7	0.8	31	25	16	5	126	10	726	No	No	No	1.2	1.1	1.1
59	HH1	MC	Mat	M		HH / 0.2 / Sh.	1	13.3	3.0	2.3	1.7	2.7	2.0	1.5	65	50	32	7	95	10	726	No	No	No	1.6	1.4	1.3
60	HM1	MC	Mat	H		HM / 0.2 / Sh.	1	13	2.3	1.5	0.9	2.0	1.4	0.8	47	37	24	7	101	10	726	No	No	No	1.4	1.2	1.1
61	HL1	MC	Over	L		HL / 0.2 / Sh.	1	31.1	1.5	0.8	0.9	1.4	0.7	0.8	31	25	16	4	83	6	239	No	No	No	1.2	1.1	1.1
62	CM1	MC	Over	M		CM / 0.2 / Sh.	3	4	9.8	6.0	3.4	8.9	5.5	3.1	22	14	8	14	22	6	239	No	No	No	3.6	2.3	1.6
63	GM1	MC	Over	H		GM / 0.2 / Sh.	1	5.2	9.0	5.3	4.3	8.2	4.8	3.9	115	95	66	6	55	6	239	YES	YES	YES	30,000.0	1,556.0	285.6

Note: Coefficients for Polynomial Equations from "Timber.xls", "Slash.xls", "Grass.xls", "Shrubs.xls"

Worksheets (Values Are Individual Fire Sizes in Acres; Units are ROS):

FCC	Carlton Mod ID	Extreme Fire Weather: Timber	Extreme: Slash	Extreme: Grass	Extreme: Shrub	Very High Fire Weather: Timber	Very High: Slash	Very High: Grass	Very High: Shrub	High Fire Weather: Timber	High: Slash	High: Grass	High: Shrub
1	HL3	1.97				1.61				1.13			
2	HM2	1.97				1.61				1.13			
3	HL3	1.97				1.61				1.13			
4	UM1	2.19				1.61				1.26			
5	CM1			3.64				2.26				1.61	
6	CH1			5.27				2.74				2.01	
7	UL1	1.61				1.39				1.26			
8	UM1	2.19				1.61				1.26			
9	HM1	1.39				1.22				1.10			
10	TM1				83.03				5.76				2.61
11	HM1	1.39				1.22				1.10			
12	UL1	1.61				1.39				1.26			
13	P												
14	KL1		2.81				2.16				1.66		
15	KL2		5.53				2.81				2.32		
16	P												
17	KL1		2.81				2.16				1.66		
18	P												
19	JL1		11666.75				777.89				3.10		
20	JL3		10121.46				1165.66				317.53		
21	P												
22	JL1		11666.75				777.89				3.10		
23	P												
24	JL1		11666.75				777.89				3.10		
25	JL3		10121.46				1165.66				317.53		
26	P												
27	JL1		11666.75				777.89				3.10		
28	KM5		30000.00				8709.29				6.33		
29	KM5		30000.00				8709.29				6.33		
30	KL3?		29913.40				3.57				2.58		
31	KM4		30000.00				5.53				4.03		
32	KM5		30000.00				8709.29				6.33		
33	KM5		30000.00				8709.29				6.33		
34	KL3?		29913.40				3.57				2.58		
35	KM5		30000.00				8709.29				6.33		
36	JL4		30000.00				4002.39				272.59		
37	JL4		30000.00				4002.39				272.59		
38	JL2		30000.00				11837.47				516.39		
39	KM5		30000.00				8709.29				6.33		
40	KM5		40.20				13.42				6.33		
41	KM5		40.20				13.42				6.33		
42	KL3?		29913.40				507.72				2.58		
43	KM5		40.20				13.42				6.33		
44	KM4		9.92				5.53				4.03		
45	KM4		9.92				5.53				4.03		
46	KL1		2.81				2.16				1.66		
47	KM4		16.92				8.22				4.80		
48	KM6		267.82				40.20				10.55		
49	KM6		267.82				40.20				10.55		
50	KL4?		16.92				6.33				3.57		
51	KH4		88.99				26.36				8.22		
52	HM1	1.39				1.22				1.10			
53	HM1	1.39				1.22				1.10			
54	HL1	1.22				1.09				1.10			
55	HM1	1.39				1.22				1.10			
56	HM1	1.39				1.22				1.10			
57	HL1	1.22				1.09				1.10			
58	HL1	1.22				1.09				1.10			
59	HH1	1.61				1.39				1.26			
60	HM1	1.39				1.22				1.10			
61	HL1	1.22				1.09				1.10			
62	CM1			3.64				2.26				1.61	
63	GM1	30000.00				1556.03				285.56			

TABLE D-1

CALCULATION OF FIRE SIZE BY FCC AND FIRE WEATHER CLASS

FETM DEVELOPMENT

OPE70167.6C.A0 MDS JUNE 7, 1994

REVISED DECEMBER 22, 1994

(Ratios of Crown/Ground ROS Added 11/20/94)

FCC	Carlton Mod ID	Veg Type	Age Class	Loading Class	Activity Class	Deeming's Extended NFDRS Fuel Models	Fuel Flag	See Carlton's 10/10/94 Notes (Extreme Only) Crown/Ground SC or ROS Ratio	Spread Component (feet/min) from PCFIRDAT Extreme (Note: ROS = SC * 0.9091)	Spread Component V. High	Spread Component High	Rate of Spread (chains/hour) Extreme	Rate of Spread V. High	Rate of Spread High	From Carlton's pcFIRDAT Passing Files, 8/14/94 Energy Release Component from PCFIRDAT Extreme	Energy Release Component V. High	Energy Release Component High	From "CRIT-SC.XLS" Critical SC for Crown Fires (feet/min)	Critical ERC for Crown Fires (feet/min)	Height to Base of Ladder Fuels (feet)	Total Tree Density (tpa)	Based on SC, ERC, and TPA Crown Fire Possible? Extreme	Crown Fire Possible? V. High	Crown Fire Possible? High	Final Fire Size (Acres) With Crowning Extreme	Final Fire Size V. High	Final Fire Size High	FCC	Carlton Mod ID	Extreme Fire Weather Timber	Extreme Fire Weather Slash	Extreme Fire Weather Grass	Extreme Fire Weather Shrub	Very High Fire Weather Timber	Very High Fire Weather Slash	Very High Fire Weather Grass	Very High Fire Weather Shrub	High Fire Weather Timber	High Fire Weather Slash	High Fire Weather Grass	High Fire Weather Shrub
64	P	MC	Imm	L	PCT/Pile	Piled	5	1	1.0	1.0	1.0	0.9	0.9	0.9	0	0	0	999	999	15	175	No	No	No	0.0	0.0	0.0	64	P												
65	KL1	MC	Imm	L	PCT/L&S	KLC / 0.2 / Sh.	2	15	2.3	1.5	0.9	2.0	1.4	0.8	56	48	36	14	86	15	175	No	No	No	2.8	2.2	1.7	65	KL1		2.81				2.16				1.66		
66	KM4	MC	Imm	L	PCT or CT/NMT	KM / 0.2 / Sh.	2	8.1	6.8	4.5	3.4	6.1	4.1	3.1	84	71	54	12	99	15	175	No	No	No	9.9	5.5	4.0	66	KM4		9.92				5.53				4.03		
67	P	MC	Imm	L	CT/Pile	Piled	5	1	1.0	1.0	1.0	0.9	0.9	0.9	0	0	0	999	999	15	175	No	No	No	0.0	0.0	0.0	67	P												
68	KL1	MC	Imm	L	CT/L&S	KLC / 0.2 / Sh.	2	15	2.3	1.5	0.9	2.0	1.4	0.8	56	48	36	14	86	15	175	No	No	No	2.8	2.2	1.7	68	KL1		2.81				2.16				1.66		
69	P	MC	Imm	M	PCT/Pile	Piled	5	1	1.0	1.0	1.0	0.9	0.9	0.9	0	0	0	999	999	15	175	No	No	No	0.0	0.0	0.0	69	P												
70	JL1	MC	Imm	M	PCT/L&S	JLC / 0.2 / Sh.	2	7.8	6.0	3.8	2.6	5.5	3.4	2.3	181	150	115	7	172	15	175	YES	No	No	11,666.8	4.5	3.1	70	JL1		11666.75				4.47				3.10		
71	JM2	MC	Imm	M	PCT or CT/NMT	JM / 0.2 / Sh.	2	3.6	12.8	8.3	6.0	11.6	7.5	5.4	254	211	163	8	158	15	175	YES	YES	YES	10,233.0	837.8	202.1	71	JM2		10232.99				837.82				202.10		
72	P	MC	Imm	M	CT/Pile	Piled	5	1	1.0	1.0	1.0	0.9	0.9	0.9	0	0	0	999	999	15	175	No	No	No	0.0	0.0	0.0	72	P												
73	KL3	MC	Imm	M	CT/L&S	KLC / 0.3 / Unsh.	2	8.9	6.0	3.0	2.0	5.5	2.7	1.8	56	48	36	21	58	15	175	No	No	No	8.2	3.6	2.6	73	KL3?		8.22				3.57				2.58		
74	P	MC	Imm	H	PCT/Pile	Piled	5	1	1.0	1.0	1.0	0.9	0.9	0.9	0	0	0	999	999	15	175	No	No	No	0.0	0.0	0.0	74	P												
75	JL1	MC	Imm	H	PCT/L&S	JLC / 0.2 / Sh.	2	7.8	6.0	3.8	2.6	5.5	3.4	2.3	181	150	115	7	172	15	175	YES	No	No	11,666.8	4.5	3.1	75	JL1		11666.75				4.47				3.10		
76	JM2	MC	Imm	H	PCT or CT/NMT	JM / 0.2 / Sh.	2	3.6	12.8	8.3	6.0	11.6	7.5	5.4	254	211	163	8	158	15	175	YES	YES	YES	10,233.0	837.8	202.1	76	JM2		10232.99				837.82				202.10		
77	P	MC	Imm	H	CT/Pile	Piled	5	1	1.0	1.0	1.0	0.9	0.9	0.9	0	0	0	999	999	15	175	No	No	No	0.0	0.0	0.0	77	P												
78	JL1	MC	Imm	H	CT/L&S	JLC / 0.2 / Sh.	2	7.8	6.0	3.8	2.6	5.5	3.4	2.3	181	150	115	7	172	15	175	YES	No	No	11,666.8	4.5	3.1	78	JL1		11666.75				4.47				3.10		
79	JM3	MC	Mat	L	Logged	JM / 0.3 / Unsh.	2	2.7	25.0	16.0	9.0	22.7	14.5	8.2	254	211	163	6	105	10	150	YES	YES	YES	30,000.0	6,875.2	336.3	79	JM3		30000.00				6875.25				336.32		
80	JM3	MC	Mat	L	Logged/NMT	JM / 0.3 / Unsh.	2	2.7	25.0	16.0	9.0	22.7	14.5	8.2	254	211	163	6	105	10	150	YES	YES	YES	30,000.0	6,875.2	336.3	80	JM3		30000.00				6875.25				336.32		
81	KL3	MC	Mat	L	Logged/Crush	KLC / 0.3 / Unsh.	2	8.9	6.0	3.0	2.0	5.5	2.7	1.8	56	48	36	13	52	10	150	YES	No	No	29,913.4	3.6	2.6	81	KL3?		29913.40				3.57				2.58		
82	KM5	MC	Mat	L	Logged/YUM	KM / 0.3 / Unsh.	2	5.6	13.0	8.0	5.0	11.8	7.3	4.5	84	71	54	10	68	10	150	YES	YES	No	30,000.0	8,709.3	6.3	82	KM5		30000.00				8709.29				6.33		
83	KM4	MC	Mat	M	Logged	KM / 0.2 / Sh.	2	8.1	6.8	4.5	3.4	6.1	4.1	3.1	84	71	54	8	81	10	150	YES	No	No	30,000.0	5.5	4.0	83	KM4		30000.00				5.53				4.03		
84	KM4	MC	Mat	M	Logged/NMT	KM / 0.2 / Sh.	2	8.1	6.8	4.5	3.4	6.1	4.1	3.1	84	71	54	8	81	10	150	YES	No	No	30,000.0	5.5	4.0	84	KM4		30000.00				5.53				4.03		
85	KL1	MC	Mat	M	Logged/Crush	KLC / 0.2 / Sh.	2	15	2.3	1.5	0.9	2.0	1.4	0.8	56	48	36	9	76	10	150	No	No	No	2.8	2.2	1.7	85	KL1		2.81				2.16				1.66		
86	KM5	MC	Mat	M	Logged/YUM	KM / 0.3 / Unsh.	2	5.6	13.0	8.0	5.0	11.8	7.3	4.5	84	71	54	10	68	10	150	YES	YES	No	30,000.0	8,709.3	6.3	86	KM5		30000.00				8709.29				6.33		
87	KH4	MC	Mat	H	Logged	KH / 0.3 / Unsh.	2	4.1	17.0	11.0	6.0	15.5	10.0	5.5	113	96	73	9	77	10	150	YES	YES	No	30,000.0	9,101.8	8.2	87	KH4		30000.00				9101.75				8.22		
88	KH4	MC	Mat	H	Logged/NMT	KH / 0.3 / Unsh.	2	4.1	17.0	11.0	6.0	15.5	10.0	5.5	113	96	73	9	77	10	150	YES	YES	No	30,000.0	9,101.8	8.2	88	KH4		30000.00				9101.75				8.22		
89	KM2	MC	Mat	H	Logged/Crush	KMC / 0.3 / Unsh.	2	6.7	10.0	7.0	4.0	9.1	6.4	3.6	87	74	56	9	76	10	150	YES	No	No	30,000.0	10.6	4.8	89	KM2		30000.00				10.55				4.80		
90	KH4	MC	Mat	H	Logged/YUM	KH / 0.3 / Unsh.	2	4.1	17.0	11.0	6.0	15.5	10.0	5.5	113	96	73	9	77	10	150	YES	YES	No	30,000.0	9,101.8	8.2	90	KH4		30000.00				9101.75				8.22		
91	KM5	MC	Over	L	Logged	KM / 0.3 / Unsh.	2	5.6	13.0	8.0	5.0	11.8	7.3	4.5	84	71	54	999	999	6	75	No	No	No	40.2	13.4	6.3	91	KM5		40.20				13.42				6.33		
92	KM5	MC	Over	L	Logged/NMT	KM / 0.3 / Unsh.	2	5.6	13.0	8.0	5.0	11.8	7.3	4.5	84	71	54	999	999	6	75	No	No	No	40.2	13.4	6.3	92	KM5		40.20				13.42				6.33		
93	KM5	MC	Over	L	Logged/Crush	KM / 0.3 / Unsh.	2	5.6	13.0	8.0	5.0	11.8	7.3	4.5	84	71	54	999	999	6	75	No	No	No	40.2	13.4	6.3	93	KM5		40.20				13.42				6.33		
94	KL3	MC	Over	L	Logged/YUM	KLC / 0.3 / Unsh.	2	8.9	6.0	3.0	2.0	5.5	2.7	1.8	56	48	36	999	999	6	75	No	No	No	8.2	3.6	2.6	94	KL3?		8.22				3.57				2.58		
95	KH4	MC	Over	M	Logged	KH / 0.3 / Unsh.	2	4.1	17.0	11.0	6.0	15.5	10.0	5.5	113	96	73	999	999	6	75	No	No	No	89.0	26.4	8.2	95	KH4		88.99				26.36				8.22		
96	KH4	MC	Over	M	Logged/NMT	KH / 0.3 / Unsh.	2	4.1	17.0	11.0	6.0	15.5	10.0	5.5	113	96	73	999	999	6	75	No	No	No	89.0	26.4	8.2	96	KH4		88.99				26.36				8.22		
97	KH4	MC	Over	M	Logged/Crush	KH / 0.3 / Unsh.	2	4.1	17.0	11.0	6.0	15.5	10.0	5.5	113	96	73	999	999	6	75	No	No	No	89.0	26.4	8.2	97	KH4		88.99				26.36				8.22		
98	KM2	MC	Over	M	Logged/YUM	KMC / 0.3 / Unsh.	2	6.7	10.0	7.0	4.0	9.1	6.4	3.6	87	74	56	999	999	6	75	No	No	No	21.2	10.6	4.8	98	KM2		21.18				10.55				4.80		
99	KH4	MC	Over	H	Logged	KH / 0.3 / Unsh.	2	4.1	17.0	11.0	6.0	15.5	10.0	5.5	113	96	73	999	999	6	75	No	No	No	89.0	26.4	8.2	99	KH4		88.99				26.36				8.22		
100	KH4	MC	Over	H	Logged/NMT	KH / 0.3 / Unsh.	2	4.1	17.0	11.0	6.0	15.5	10.0	5.5	113	96	73	999	999	6	75	No	No	No	89.0	26.4	8.2	100	KH4		88.99				26.36				8.22		
101	KH4	MC	Over	H	Logged/Crush	KH / 0.3 / Unsh.	2	4.1	17.0	11.0	6.0	15.5	10.0	5.5	113	96	73	999	999	6	75	No	No	No	89.0	26.4	8.2	101	KH4		88.99				26.36				8.22		
102	KM2	MC	Over	H	Logged/YUM	KMC / 0.3 / Unsh.	2	6.7	10.0	7.0	4.0	9.1	6.4	3.6	87	74	56	999	999	6	75	No	No	No	21.2	10.6	4.8	102	KM2		21.18				10.55				4.80		
103	HL2	LP	Bare	L		HL / 0.3 / Unsh.	1	17.8	3.0	2.0	1.0	2.7	1.8	0.9	31	25	16	999	999	-	0	No	No	No	1.6	1.3	1.1	103	HL2	1.61				1.33				1.13			
104	HL2	LP	Bare	M		HL / 0.3 / Unsh.	1	17.8	3.0	2.0	1.0	2.7	1.8	0.9	31	25	16	999	999	-	0	No	No	No	1.6	1.3	1.1	104	HL2	1.61				1.33				1.13			
105	HH2	LP	Bare	H		HH / 0.3 / Unsh.	1	9.5	7.0	4.0	2.0	6.4	3.6	1.8	65	50	32	999	999	-	0	No	No	No	3.9	2.0	1.3	105	HH2	3.89				1.97				1.33			
106	HM1	LP	Imm	L		HM / 0.2 / Sh.	1	13	2.3	1.5	0.9	2.0	1.4	0.8	47	37	24	6	94	9	2866	No	No	No	1.4	1.2	1.1	106	HM1	1.39				1.22				1.10			
107	GM1	LP	Imm	M		GM / 0.2 / Sh.	1	5.2	9.0	5.3	4.3	8.2	4.8	3.9	115	95	66	8	70	9	2866	YES	YES	No	30,000.0	1,556.0	2.1	107	GM1	30000.00				1556.03				2.08			
108	GH1	LP	Imm	H		GH / 0.2 / Sh.	1	3.9	11.3	7.5	5.1	10.2	6.8	4.6	115	95	66	8	74	9	2866	YES	YES	No	30,000.0	3,001.7	2.5	108	GH1	30000.00				3001.71				2.50			
109	HM1	LP	Mat	L		HM / 0.2 / Sh.	1	13	2.3	1.5	0.9	2.0	1.4	0.8	47	37	24	9	129	15	1025	No	No	No	1.4	1.2	1.1	109	HM1	1.39				1.22				1.10			
110	GM1	LP	Mat	M		GM / 0.2 / Sh.	1	5.2	9.0	5.3	4.3	8.2	4.8	3.9	115	95	66	13	93	15	1025	YES	YES	No	30,000.0	1,556.0	2.1	110	GM1	30000.00				1556.03				2.08			
111	GM1	LP	Mat	H		GM / 0.2 / Sh.	1	5.2	9.0	5.3	4.3	8.2	4.8	3.9	115	95	66	13	93	15	1025	YES	YES	No	30,000.0	1,556.0	2.1	111	GM1	30000.00				1556.03				2.08			
112	HL1	LP	Over	L		HL / 0.2 / Sh.	1	31.1	1.5	0.8	0.9	1.4	0.7	0.8	31	25	16	5	126	10	369	No	No	No	1.2	1.1	1.1	112	HL1	1.22				1.09				1.10			
113	HM1	LP	Over	M		HM / 0.2 / Sh.	1	13	2.3	1.5	0.9	2.0	1.4	0.8	47	37	24	7	101	10	369	No	No	No	1.4	1.2	1.1	113	HM1	1.39				1.22				1.10			
114	GM1	LP	Over	H		GM / 0.2 / Sh.	1	5.2	9.0	5.3	4.3	8.2	4.8	3.9	115	95	66	9	75	10	369	YES	YES	No	30,000.0	1,556.0	2.1	114	GM1	30000.00				1556.03				2.08			
115	P	LP	Imm	L	PCT/Pile	Piled	5	1	1.0	1.0	1.0	0.9	0.9	0.9	0	0	0	999	999	9	175	No	No	No	0.0	0.0	0.0	115	P												
116	KL1	LP	Imm	L	PCT/L&S	KLC / 0.2 / Sh.	2	15	2.3	1.5	0.9	2.0	1.4	0.8	56	48	36	8	73	9	175	No	No	No	2.8	2.2	1.7	116	KL1		2.81				2.16				1.66		
117	KL2	LP	Imm	L	PCT or CT/NMT	KL / 0.2 / Sh.	2	10.4	4.5	2.3	1.7	4.1	2.0	1.5	53	44	34	9	65	9	175	No	No	No	5.5	2.8	2.3	117	KL2		5.53				2.81				2.32		
118	P	LP	Imm	L	CT/Pile	Piled	5	1	1.0	1.0	1.0	0.9	0.9	0.9	0	0	0	999	999	9	175	No	No	No	0.0	0.0	0.0	118	P												
119	KL1	LP	Imm	L	CT/L&S	KLC / 0.2 / Sh.	2	15	2.3	1.5	0.9	2.0	1.4	0.8	56	48	36	8	73	9	175	No	No	No	2.8	2.2	1.7	119	KL1		2.81				2.16				1.66		
120	P	LP	Imm	M	PCT/Pile	Piled	5	1	1.0	1.0	1.0	0.9	0.9	0.9	0	0	0	999	999	9	175	No	No	No	0.0	0.0	0.0	120	P												
121	KM1	LP	Imm	M	PCT/L&S	KMC / 0.2 / Sh.	2	9.2	7.5	5.3	3.4	6.8	4.8	3.1	87	74	56	7	87	9	175	YES	No	No	30,000.0	6.8	4.0	121	KM1		30000.00				6.77				4.03		
122	KH3	LP	Imm	M	PCT or CT/NMT	KH / 0.2 / Sh.	2	6.3	9.0	6.0	4.3	8.2	5.5	3.9	119	101	77	7	83	9	175	YES	YES	No	30,000.0	3,038.5	5.2	122	KH3		30000.00				3038.47				5.16		
123	P	LP	Imm	M	CT/Pile	Piled	5	1	1.0	1.0	1.0	0.9	0.9	0.9	0	0	0	999	999	9	175	No	No	No	0.0	0.0	0.0	123	P												
124	KL1	LP	Imm	M	CT/L&S	KLC / 0.2 / Sh.	2	15	2.3	1.5	0.9	2.0	1.4	0.8	56	48	36	8	73	9	175	No	No	No	2.8	2.2	1.7	124	KL1		2.81				2.16				1.66		
125	P	LP	Imm	H	PCT/Pile	Piled	5	1	1.0	1.0	1.0	0.9	0.9	0.9	0	0	0	999	999	9	175	No	No	No	0.0	0.0	0.0	125	P												
126	JL1	LP	Imm	H	PCT/L&S	JLC / 0.2 / Sh.	2	7.8	6.0	3.8	2.6	5.5	3.4	2.3	181	150	115	5	127	9	175	YES	YES	No	11,666.8	777.9	3.1	126	JL1		11666.75				777.89				3.10		

Note: Coefficients for Polynomial Equations from "Timber.xls", "Slash.xls", "Grass.xls", "Shrubs.xls"

Worksheets (Values Are Individual Fire Sizes in Acres; Units are ROS):

TABLE D-1
CALCULATION OF FIRE SIZE BY FCC AND FIRE WEATHER CLASS
FETM DEVELOPMENT
OPE70167.6C.A0 MDS JUNE 7, 1994
REVISED DECEMBER 22, 1994
(Ratios of Crown/Ground ROS Added 11/20/94)

Note: ROS = SC * 0.9091 (Spread Component → Rate of Spread). Energy Release Component: From Carlton's pcFIRDAT Passing Files, 8/14/94. Critical SC / Critical ERC / Height to Base of Ladder Fuels: From "CRIT-SC.XLS". Crown/Ground SC or ROS Ratio: See Carlton's 10/10/94 Notes (Extreme Only). Crown Fire Possible?: Based on SC, ERC, and TPA.

Note: Coefficients for Polynomial Equations from "Timber.xls", "Slash.xls", "Grass.xls", "Shrubs.xls"

Worksheets (Values Are Individual Fire Sizes in Acres; Units are ROS):

FCC	Carlton Mod ID	Veg Type	Age Class	Loading Class	Activity Class	Deeming's Extended NFDRS Fuel Models	Fuel Flag	Crown/Ground SC or ROS Ratio	Spread Component (feet/min) from PCFIRDAT Extreme	Spread Component V. High	Spread Component High	Rate of Spread (chains/hour) Extreme	Rate of Spread V. High	Rate of Spread High	Energy Release Component from PCFIRDAT Extreme	ERC V. High	ERC High	Critical SC for Crown Fires (feet/min)	Critical ERC for Crown Fires (feet/min)	Height to Base of Ladder Fuels (feet)	Total Tree Density (tpa)	Crown Fire Possible? Extreme	Crown Fire Possible? V. High	Crown Fire Possible? High	Final Fire Size (Acres) With Crowning Extreme	Final Fire Size V. High	Final Fire Size High	FCC	Carlton Mod ID	Extreme Fire Weather Timber	Extreme Slash	Extreme Grass	Extreme Shrub	Very High Fire Weather Timber	Very High Slash	Very High Grass	Very High Shrub	High Fire Weather Timber	High Slash	High Grass	High Shrub
127	JL3	LP	Imm	H	PCT or CT/NMT	JL / 0.2 / Sh.	2	4.7	9.8	6.8	5.1	8.9	6.1	4.6	191	160	123	5	106	9	175	YES	YES	YES	10,121.5	1,165.7	317.5	127	JL3		10121.46				1165.66				317.53		
128	P	LP	Imm	H	CT/Pile	Piled	5	1	1.0	1.0	1.0	0.9	0.9	0.9	0	0	0	999	999	9	175	No	No	No	0.0	0.0	0.0	128	P												
129	JL1	LP	Imm	H	CT/L&S	JLC / 0.2 / Sh.	2	7.8	6.0	3.8	2.6	5.5	3.4	2.3	181	150	115	5	127	9	175	YES	YES	No	11,666.8	777.9	3.1	129	JL1		11666.75				777.89				3.10		
130	KM6	LP	Mat	L	Logged	KM / 0.5 / Unsh.	2	4.2	23.0	13.0	7.0	20.9	11.8	6.4	84	71	54	18	67	15	225	YES	YES	No	30,000.0	30,000.0	10.6	130	KM6		30000.00				30000.00				10.55		
131	KM6	LP	Mat	L	Logged/NMT	KM / 0.5 / Unsh.	2	4.2	23.0	13.0	7.0	20.9	11.8	6.4	84	71	54	18	67	15	225	YES	YES	No	30,000.0	30,000.0	10.6	131	KM6		30000.00				30000.00				10.55		
132	KL4	LP	Mat	L	Logged/Crush	KLC / 0.5 / Unsh.	2	8.5	9.0	5.0	3.0	8.2	4.5	2.7	56	48	36	21	58	15	225	No	No	No	16.9	6.3	3.6	132	KL4?		16.92				6.33				3.57		
133	KM6	LP	Mat	L	Logged/YUM	KM / 0.5 / Unsh.	2	4.2	23.0	13.0	7.0	20.9	11.8	6.4	84	71	54	18	67	15	225	YES	YES	No	30,000.0	30,000.0	10.6	133	KM6		30000.00				30000.00				10.55		
134	KM4	LP	Mat	M	Logged	KM / 0.2 / Sh.	2	8.1	6.8	4.5	3.4	6.1	4.1	3.1	84	71	54	12	99	15	225	No	No	No	9.9	5.5	4.0	134	KM4		9.92				5.53				4.03		
135	KM4	LP	Mat	M	Logged/NMT	KM / 0.2 / Sh.	2	8.1	6.8	4.5	3.4	6.1	4.1	3.1	84	71	54	12	99	15	225	No	No	No	9.9	5.5	4.0	135	KM4		9.92				5.53				4.03		
136	KL1	LP	Mat	M	Logged/Crush	KLC / 0.2 / Sh.	2	15	2.3	1.5	0.9	2.0	1.4	0.8	56	48	36	14	86	15	225	No	No	No	2.8	2.2	1.7	136	KL1		2.81				2.16				1.66		
137	KM4	LP	Mat	M	Logged/YUM	KM / 0.2 / Sh.	2	8.1	6.8	4.5	3.4	6.1	4.1	3.1	84	71	54	12	99	15	225	No	No	No	9.9	5.5	4.0	137	KM4		9.92				5.53				4.03		
138	KH3	LP	Mat	H	Logged	KH / 0.2 / Sh.	2	6.3	9.0	6.0	4.3	8.2	5.5	3.9	119	101	77	11	110	15	225	YES	No	No	30,000.0	8.2	5.2	138	KH3		30000.00				8.22				5.16		
139	KH3	LP	Mat	H	Logged/NMT	KH / 0.2 / Sh.	2	6.3	9.0	6.0	4.3	8.2	5.5	3.9	119	101	77	11	110	15	225	YES	No	No	30,000.0	8.2	5.2	139	KH3		30000.00				8.22				5.16		
140	KM1	LP	Mat	H	Logged/Crush	KMC / 0.2 / Sh.	2	9.2	7.5	5.3	3.4	6.8	4.8	3.1	87	74	56	11	111	15	225	No	No	No	11.9	6.8	4.0	140	KM1		11.91				6.77				4.03		
141	KH3	LP	Mat	H	Logged/YUM	KH / 0.2 / Sh.	2	6.3	9.0	6.0	4.3	8.2	5.5	3.9	119	101	77	11	110	15	225	YES	No	No	30,000.0	8.2	5.2	141	KH3		30000.00				8.22				5.16		
142	KM4	LP	Over	L	Logged	KM / 0.2 / Sh.	2	8.1	6.8	4.5	3.4	6.1	4.1	3.1	84	71	54	8	81	10	>100?	YES	No	No	30,000.0	5.5	4.0	142	KM4		30000.00				5.53				4.03		
143	KM4	LP	Over	L	Logged/NMT	KM / 0.2 / Sh.	2	8.1	6.8	4.5	3.4	6.1	4.1	3.1	84	71	54	8	81	10	>100?	YES	No	No	30,000.0	5.5	4.0	143	KM4		30000.00				5.53				4.03		
144	KL1	LP	Over	L	Logged/Crush	KLC / 0.2 / Sh.	2	15	2.3	1.5	0.9	.2.0	1.4	0.8	56	48	36	9	76	10	101	No	No	No	2.8	2.2	1.7	144	KL1		2.81				2.16				1.66		
145	KM4	LP	Over	L	Logged/YUM	KM / 0.2 / Sh.	2	8.1	6.8	4.5	3.4	6.1	4.1	3.1	84	71	54	8	81	10	>100?	YES	No	No	30,000.0	5.5	4.0	145	KM4		30000.00				5.53				4.03		
146	KM4	LP	Over	M	Logged	KM / 0.2 / Sh.	2	8.1	6.8	4.5	3.4	6.1	4.1	3.1	84	71	54	8	81	10	>100?	YES	No	No	30,000.0	5.5	4.0	146	KM4		30000.00				5.53				4.03		
147	KM4	LP	Over	M	Logged/NMT	KM / 0.2 / Sh.	2	8.1	6.8	4.5	3.4	6.1	4.1	3.1	84	71	54	8	81	10	>100?	YES	No	No	30,000.0	5.5	4.0	147	KM4		30000.00				5.53				4.03		
148	KL1	LP	Over	M	Logged/Crush	KLC / 0.2 / Sh.	2	15	2.3	1.5	0.9	2.0	1.4	0.8	56	48	36	9	76	10	101	No	No	No	2.8	2.2	1.7	148	KL1		2.81				2.16				1.66		
149	KM4	LP	Over	M	Logged/YUM	KM / 0.2 / Sh.	2	8.1	6.8	4.5	3.4	6.1	4.1	3.1	84	71	54	8	81	10	>100?	YES	No	No	30,000.0	5.5	4.0	149	KM4		30000.00				5.53				4.03		
150	KH3	LP	Over	H	Logged	KH / 0.2 / Sh.	2	6.3	9.0	6.0	4.3	8.2	5.5	3.9	119	101	77	8	88	10	175	YES	YES	No	30,000.0	3,038.5	5.2	150	KH3		30000.00				3038.47				5.16		
151	KH3	LP	Over	H	Logged/NMT	KH / 0.2 / Sh.	2	6.3	9.0	6.0	4.3	8.2	5.5	3.9	119	101	77	8	88	10	175	YES	YES	No	30,000.0	3,038.5	5.2	151	KH3		30000.00				3038.47				5.16		
152	KM1	LP	Over	H	Logged/Crush	KMC / 0.2 / Sh.	2	9.2	7.5	5.3	3.4	6.8	4.8	3.1	87	74	56	7	92	10	101	YES	No	No	30,000.0	6.8	4.0	152	KM1		30000.00				6.77				4.03		
153	KH3	LP	Over	H	Logged/YUM	KH / 0.2 / Sh.	2	6.3	9.0	6.0	4.3	8.2	5.5	3.9	119	101	77	8	88	10	175	YES	YES	No	30,000.0	3,038.5	5.2	153	KH3		30000.00				3038.47				5.16		
154	TM3	WJ	Bare	L		TM / 0.5 / Unsh.	4	1.3	41.0	13.0	4.0	37.3	11.8	3.6	21	13	4	999	999	-	0	No	No	No	1,754.1	14.1	2.5	154	TM3				1754.11				14.05				2.48
155	TM3	WJ	Bare	M		TM / 0.5 / Unsh.	4	1.3	41.0	13.0	4.0	37.3	11.8	3.6	21	13	4	999	999	-	0	No	No	No	1,754.1	14.1	2.5	155	TM3				1754.11				14.05				2.48
156	TM3	WJ	Bare	H		TM / 0.5 / Unsh.	4	1.3	41.0	13.0	4.0	37.3	11.8	3.6	21	13	4	999	999	-	0	No	No	No	1,754.1	14.1	2.5	156	TM3				1754.11				14.05				2.48
157	TM3	WJ	Imm	L		TM / 0.5 / Unsh.	4	1.3	41.0	13.0	4.0	37.3	11.8	3.6	21	13	4	6	4	1	107	YES	YES	YES	12,972.8	28.5	3.2	157	TM3				12972.75				28.52				3.17
158	TM3	WJ	Imm	M		TM / 0.5 / Unsh.	4	1.3	41.0	13.0	4.0	37.3	11.8	3.6	21	13	4	6	4	1	107	YES	YES	YES	12,972.8	28.5	3.2	158	TM3				12972.75				28.52				3.17
159	TM3	WJ	Imm	H		TM / 0.5 / Unsh.	4	1.3	41.0	13.0	4.0	37.3	11.8	3.6	21	13	4	6	4	1	107	YES	YES	YES	12,972.8	28.5	3.2	159	TM3				12972.75				28.52				3.17
160	TH2	WJ	Mat	L		TH / 0.5 / Unsh.	4	1.2	49.0	18.0	6.0	44.5	16.4	5.5	28	19	5	14	8	3	107	YES	YES	No	30,000.0	65.6	3.7	160	TH2				30000.00				65.59				3.72
161	TH2	WJ	Mat	M		TH / 0.5 / Unsh.	4	1.2	49.0	18.0	6.0	44.5	16.4	5.5	28	19	5	14	8	3	107	YES	YES	No	30,000.0	65.6	3.7	161	TH2				30000.00				65.59				3.72
162	TH2	WJ	Mat	H		TH / 0.6 / Unsh.	4	1.2	49.0	18.0	6.0	44.5	16.4	5.5	28	19	5	14	8	3	107	YES	YES	No	30,000.0	65.6	3.7	162	TH2				30000.00				65.59				3.72
163	AL2	Grass	Mat	L		AL / 0.5 / Unsh.	3	1.1	40.0	29.0	20.0	36.4	26.4	18.2	2	1	0	999	999	-	0	No	No	No	133.7	37.1	12.7	163	AL2			133.66				37.08				12.73	
164	AL1	Grass/PF	Mat	L		AL / 0.2 / Sh.	3	1.9	18.8	12.0	7.7	17.0	10.9	7.0	2	1	0	65	7	8	297	No	No	No	11.0	4.8	2.8	164	AL1			10.95				4.81				2.79	
165	SH1	Grass/LF	Mat	L		SH / 0.2 / Sh.	3	7.3	4.5	3.0	1.7	4.1	2.7	1.5	36	28	19	20	60	15	1025	No	No	No	1.9	1.5	1.3	165	SH1			1.86				1.53				1.28	
166	LL2	Grass	Mat	M		LL / 0.5 / Unsh.	3	1	47.0	30.0	16.0	42.7	27.3	14.5	4	2	1	999	999	-	0	No	No	No	299.0	41.7	7.9	166	LL2			299.04				41.71				7.85	
167	UL1	Grass/PF	Mat	M		UL / 0.2 / Sh.	1	12.2	3.0	2.3	1.7	2.7	2.0	1.5	31	25	18	10	50	8	307	No	No	No	1.6	1.4	1.3	167	UL1	1.61				1.39				1.26			
168	UL1	Grass/LF	Mat	M		UL / 0.2 / Sh.	1	12.2	3.0	2.3	1.7	2.7	2.0	1.5	31	25	18	19	66	15	1025	No	No	No	1.6	1.4	1.3	168	UL1	1.61				1.39				1.26			
169	LL2	Grass	Mat	H		LL / 0.5 / Unsh.	3	1	47.0	30.0	16.0	42.7	27.3	14.5	4	2	1	999	999	-	0	No	No	No	299.0	41.7	7.9	169	LL2			299.04				41.71				7.85	
170	UM1	Grass/PF	Mat	H		UM / 0.2 / Sh.	1	8.1	4.5	3.0	1.7	4.1	2.7	1.5	50	37	26	8	56	8	297	No	No	No	2.2	1.6	1.3	170	UM1	2.19				1.61				1.26			
171	HM1	Grass/LF	Mat	H		HM / 0.2 / Sh.	1	13	2.3	1.5	0.9	2.0	1.4	0.8	47	37	24	9	129	15	1025	No	No	No	1.4	1.2	1.1	171	HM1	1.39				1.22				1.10			
172	FM1	Shrub	Imm	L		FM / 0.3 / Unsh.	4	1	30.0	9.0	5.0	27.3	8.2	4.5	60	26	16	999	999	-	0	No	No	No	278.9	6.7	3.0	172	FM1				278.93				6.65				3.04
173	FM1	Shrub	Imm	M		FM / 0.3 / Unsh.	4	1	30.0	9.0	5.0	27.3	8.2	4.5	60	26	16	999	999	-	0	No	No	No	278.9	6.7	3.0	173	FM1				278.93				6.65				3.04
174	FM1	Shrub	Imm	H		FM / 0.3 / Unsh.	4	1	30.0	9.0	5.0	27.3	8.2	4.5	60	26	16	999	999	-	0	No	No	No	278.9	6.7	3.0	174	FM1				278.93				6.65				3.04
175	FM1	Shrub	Mat	L		FM / 0.3 / Unsh.	4	1	30.0	9.0	5.0	27.3	8.2	4.5	60	26	16	999	999	-	0	No	No	No	278.9	6.7	3.0	175	FM1				278.93				6.65				3.04
176	FM1	Shrub	Mat	M		FM / 0.3 / Unsh.	4	1	30.0	9.0	5.0	27.3	8.2	4.5	60	26	16	999	999	-	0	No	No	No	278.9	6.7	3.0	176	FM1				278.93				6.65				3.04
177	FM1	Shrub	Mat	H		FM / 0.3 / Unsh.	4	1	30.0	9.0	5.0	27.3	8.2	4.5	60	26	16	999	999	-	0	No	No	No	278.9	6.7	3.0	177	FM1				278.93				6.65				3.04
178	TL1	Shrub/MC	Imm	L		TL / 0.2 / Sh.	4	4.4	9.0	5.3	3.4	8.2	4.8	3.1	14	8	2	34	36	15	1486	No	No	No	6.7	3.2	2.2	178	TL1				6.65				3.20				2.19
179	TM1	Shrub/MC	Imm	M		TM / 0.2 / Sh.	4	1.7	13.5	8.3	4.3	12.3	7.5	3.9	21	13	4	34	36	15	1486	No	No	No	15.4	5.8	2.6	179	TM1				15.40				5.76				2.61
180	TH1	Shrub/MC	Imm	H		TH / 0.3 / Unsh.	4	2	38.0	17.0	6.0	34.5	15.5	5.5	28	19	5	42	29	15	1486	No	No	No	1,068.0	29.0	3.7	180	TH1				1067.97				29.04				3.72
181	TL1	Shrub/MC	Mat	L		TL / 0.2 / Sh.	4	4.4	9.0	5.3	3.4	8.2	4.8	3.1	14	8	2	24	28	10	726	No	No	No	6.7	3.2	2.2	181	TL1				6.65				3.20				2.19
182	TM1	Shrub/MC	Mat	M		TM / 0.2 / Sh.	4	1.7	13.5	8.3	4.3	12.3	7.5	3.9	21	13	4	24	27	10	726	No	No	No	15.4	5.8	2.6	182	TM1				15.40				5.76				2.61
183	TH1	Shrub/MC	Mat	H		TH / 0.3 / Unsh.	4	2	38.0	17.0	6.0	34.5	15.5	5.5	28	19	5	29	23	10	726	YES	No	No	30,000.0	29.0	3.7	183	TH1				30000.00				29.04				3.72
184	TM2	PP	Mat	L-		TM / 0.3 / Unsh.	4	1.9	28.0	12.0	5.0	25.5	10.9	4.5	21	13	4	25	19	8	297	YES	No	No	12,765.9	11.7	3.0	184	TM2				12765.88				11.68				3.04
185	UL2	PP	Over	L-		UL / 0.3 / Unsh.	1	9.5	7.0	4.0	2.0	6.4	3.6	1.8	31	25	18	9	34	6	836	No	No	No	3.9	2.0	1.3	185	UL2	3.89				1.97				1.33			
186	HL1	MC	Mat	L-		HL / 0.2 / Sh.	1	31.1	1.5	0.8	0.9	1.4	0.7	0.8	31	25	16	5	126	10	726	No	No	No	1.2	1.1	1.1	186	HL1	1.22				1.09				1.10			
187	HL1	MC	Over	L-		HL / 0.2 / Sh.	1	31.1	1.5	0.8	0.9	1.4	0.7	0.8	31	25	16	4	83	6	239	No	No	No	1.2	1.1	1.1	187	HL1	1.22				1.09				1.10			
188	HL1	LP	Imm	L-		HL / 0.2 / Sh.	1	31.1	1.5	0.8	0.9	1.4	0.7	0.8	31	25	16	5	115	9	2866	No	No	No	1.2	1.1	1.1	188	HL1	1.22				1.09				1.10			
																									mean	mean	mean														

TABLE D-1
CALCULATION OF FIRE SIZE BY FCC AND FIRE WEATHER CLASS
FETM DEVELOPMENT
OPE70167.6C.A0 MDS JUNE 7, 1994
REVISED DECEMBER 22, 1994
(Ratios of Crown/Ground ROS Added 11/20/94)

Note: Coefficients for Polynomial Equations from "Timber.xls", "Slash.xls", "Grass.xls", "Shrubs.xls"

Worksheets (Values Are Individual Fire Sizes in Acres; Units are ROS):

								See Carlton's 10/10/94 Notes (Extreme Only)	Note: ROS = SC * 0.9091						*From Carlton's pcFIRDAT Passing Files, 8/14/94*			*From "CRIT-SC.XLS"*					*Based on SC, ERC, and TPA*																					
						Deeming's Extended NFDRS		Crown/Ground	Spread Component (feet/min) from PCFIRDAT			Rate of Spread (chains/hour)			Energy Release Component from PCFIRDAT			Critical SC for Crown Fires	Critical ERC for Crown Fires	Height to Base of Ladder Fuels	Total Tree Density		Crown Fire Possible?				**Final Fire Size (Acres) With Crowning**					Carlton	Extreme Fire Weather				Very High Fire Weather				High Fire Weather			
FCC	Carlton Mod ID	Veg Type	Age Class	Loading Class	Activity Class	Fuel Models	Fuel Flag	SC or ROS Ratio	Extreme	V. High	High	Extreme	V. High	High	Extreme	V. High	High	(feet/min)	(feet/min)	(feet)	(tpa)		Extreme	V. High	High		**Extreme**	**V. High**	**High**		FCC	Mod ID	Timber	Slash	Grass	Shrub	Timber	Slash	Grass	Shrub	Timber	Slash	Grass	Shrub
																											9,456.1	1,356.8	21.1															

Appendix E

Transition Matrix Data Files